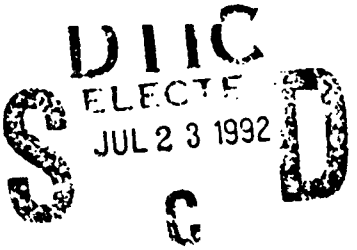


(2)

REPORT

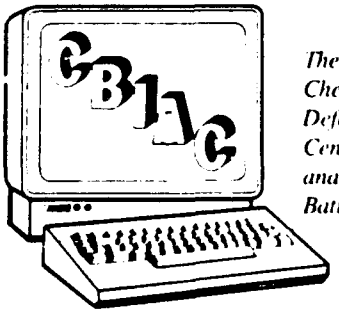
FINAL REPORT

Novel Seals and Specialty Component Attachment Mechanisms for Respiratory Protection System 21 (RESPO 21)

To

U.S. Army Chemical Research, Development, and Engineering Center

October, 1992



The Chemical Warfare/ Chemical and Biological Defense Information Analysis Center is a DoD information analysis center operated by Battelle Memorial Institute

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Putting Technology To Work

FINAL REPORT

on

NOVEL SEALS AND SPECIALTY COMPONENT ATTACHMENT MECHANISMS FOR RESPIRATORY PROTECTION SYSTEM 21 (RESPO 21)

to

U.S. ARMY CHEMICAL RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER
ABERDEEN PROVING GROUND MD 21010-5423

October, 1990

by

Thomas A. Pettenski

BATTELLE
505 King Avenue
Columbus, Ohio 43201

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NOVEL SEALS AND SPECIALTY COMPONENT ATTACHMENT MECHANISMS FOR RESPIRATORY PROTECTION SYSTEM 21 (RESPO 21)

INTRODUCTION

This program was conducted to establish the design characteristics of attachment mechanisms for use in the mounting of mask seals and specialty components into the Respiratory Protection System 21 (RESPO 21). These design characteristics include but are not limited to keeping the seal/attachment mechanism low in profile, allowing easy seal or component replacement, and incorporating multiple layers of material within the seal and attachment mechanism.

Alternative seal concepts were investigated for the interface between the mask and the mask wearer. These concepts include pneumatic bladders, encapsulated gels, laminated foams, and combinations of the above. Prototype seals of the encapsulated gel-type and the pneumatic type were fabricated to demonstrate feasibility and assist with the development of attachment mechanisms. Approaches for attaching a seal to a mask, both hard-shell and softshell, were identified. None were fabricated due to time limitations and availability of appropriate seals and masks.

BACKGROUND

The Chemical Research, Development, and Engineering Center (CRDEC) is entering development of the next generation of respiratory protection known as RESPO 21. Early concept development efforts indicated an immediate need for advanced sealing techniques and specialty component attachment mechanisms. The mask prototypes currently under consideration for seal and attachment mechanism development are the hardshell or rigid facepiece mask and the softshell or semi-rigid mask.

The hardshell mask is comprised of modular components which include the rigid facepiece, a sealing inner liner, and a hood that would provide attachment means for the facepiece and liner. The rigid facepiece is being considered because of the potential for limited fragment protection.

The semi-rigid mask is an integral multi-layer mask that includes a hood with liner attached to a flexible facepiece with a barrier film cover.

In addition to the work on this task, there are other programs currently being conducted for the development of RESPO 21. These programs include development of a master control unit for respiratory protection equipment and evaluation of lens defog in a protective mask.

OBJECTIVE

The objective of this task was to identify and demonstrate novel seal and component attachment system options for use in the next generation of respiratory protection equipment known as RESPO 21.

TECHNICAL APPROACH

Establish Seal Design Characteristics

In order to design and develop seals or sealing techniques for RESPO 21, several design characteristics were identified. The seal should be low in profile, thus keeping the mask close to the face and head of the mask wearer. The seal may incorporate layers of different material to supplement conformability as well as improved contact for an integral seal. These layers may include pneumatic bladders, silicone gels, and foams encapsulated in a pliable skin. It is also desirable for the seal to be replaceable, and thus the seal needs to be considered as a separate entity and not an integral part of the final mask design. Since RESPO 21 is currently under development and undergoing various changes, the seal design should be flexible to accommodate a variety of design options.

The area of interest for the mask seal development is concentrated on the interface around the periphery of the face and, in addition, the area surrounding the nose and mouth of the mask wearer referred to as the "nosecup". During this program, due to time and cost limitations, we were only concerned with the seal area surrounding the face.

Review Existing Seals

In order to better understand the challenge of maintaining a seal for respiratory protection, a literature scan was performed of existing seals and seal type materials. This scan included patent searches, abstracts on related topics, commercial vendors of health and safety equipment, scuba diving equipment, snow skiing masks, and various miscellaneous items relating to seal technology. A listing of the relevant patents and vendors is provided in Appendix A.

Some of the more relevant examples of materials relating to mask seal development are: a biosoft gel bicycle seat cover made by Spenco, a pair of Clear Comfort gel/foam ear cushions for an aviation headset made by Bose, and an inflatable bladder used in "the Pump", an athletic shoe made by Reebok.

Seal Physical Properties

The physical properties required for a mask seal were assumed to include flexibility, conformability, ruggedness, non-irritating to human skin, resistant to sweat, resistant to chemical agent decontaminants, and functional over a broad range of environmental conditions including temperature and humidity.

For this program, the seal area is considered to be that surrounding the face. Thus, the seal area crosses the forehead, drops along the sides of the face across the cheeks, and joins together under the chin. A line drawing of the seal contact area is shown in Figure 1. This drawing was generated from coordinate points furnished by CRDEC and by scaling dimensions from a three-dimensional computer model (see Figure 2) of a mask seal also obtained from CRDEC.

Identify Types of Seals

There are many types of seals and seal materials to choose from for consideration for sealing around the periphery of the face. Some of the choices include: foam, encapsulated gels, pneumatic bladders, and combinations of the above. Laminated foams have been used as headphone ear cushions and provide a conforming interface between the headphone speaker and the headphone

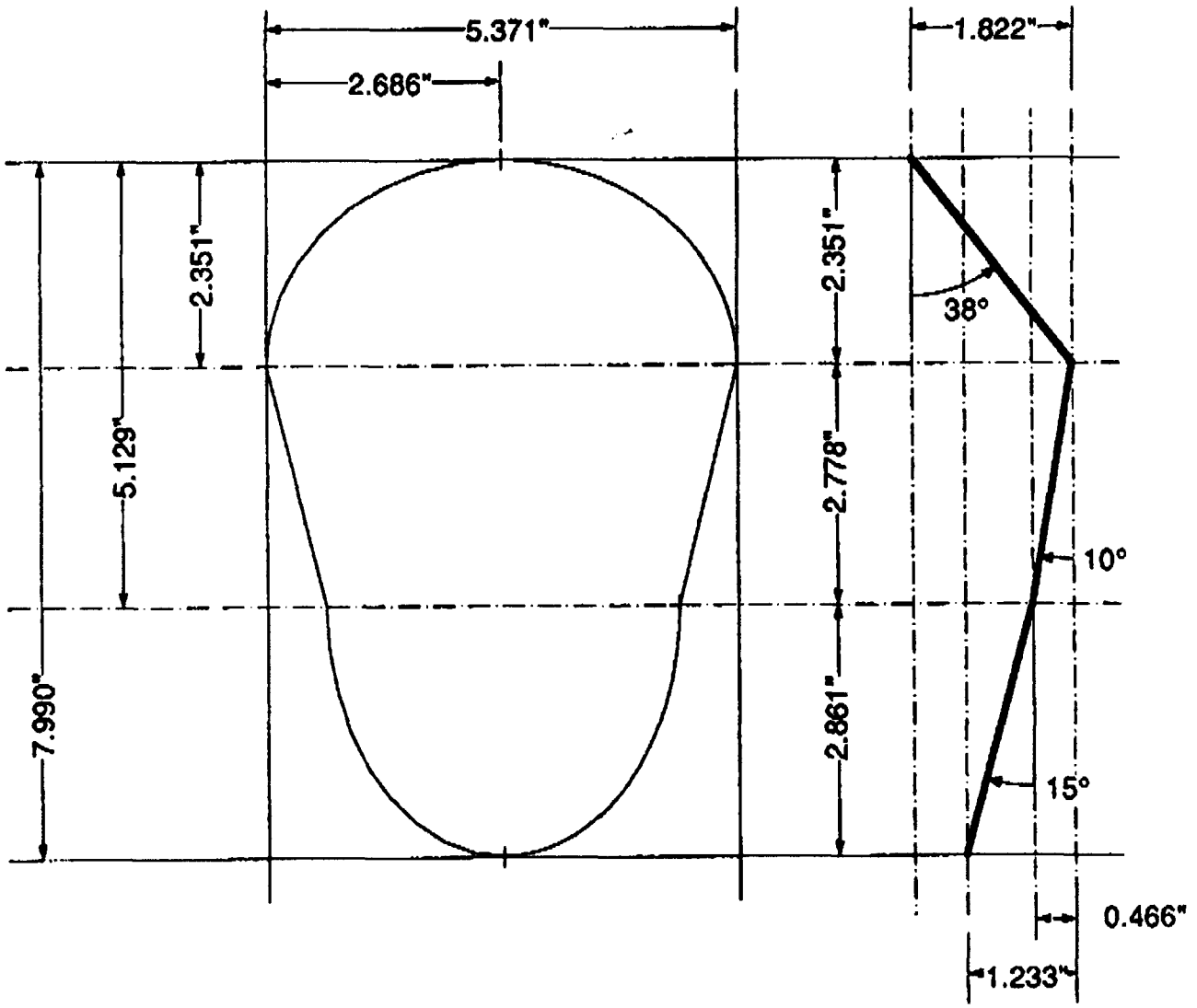


FIGURE 1. SEAL CONTACT AREA

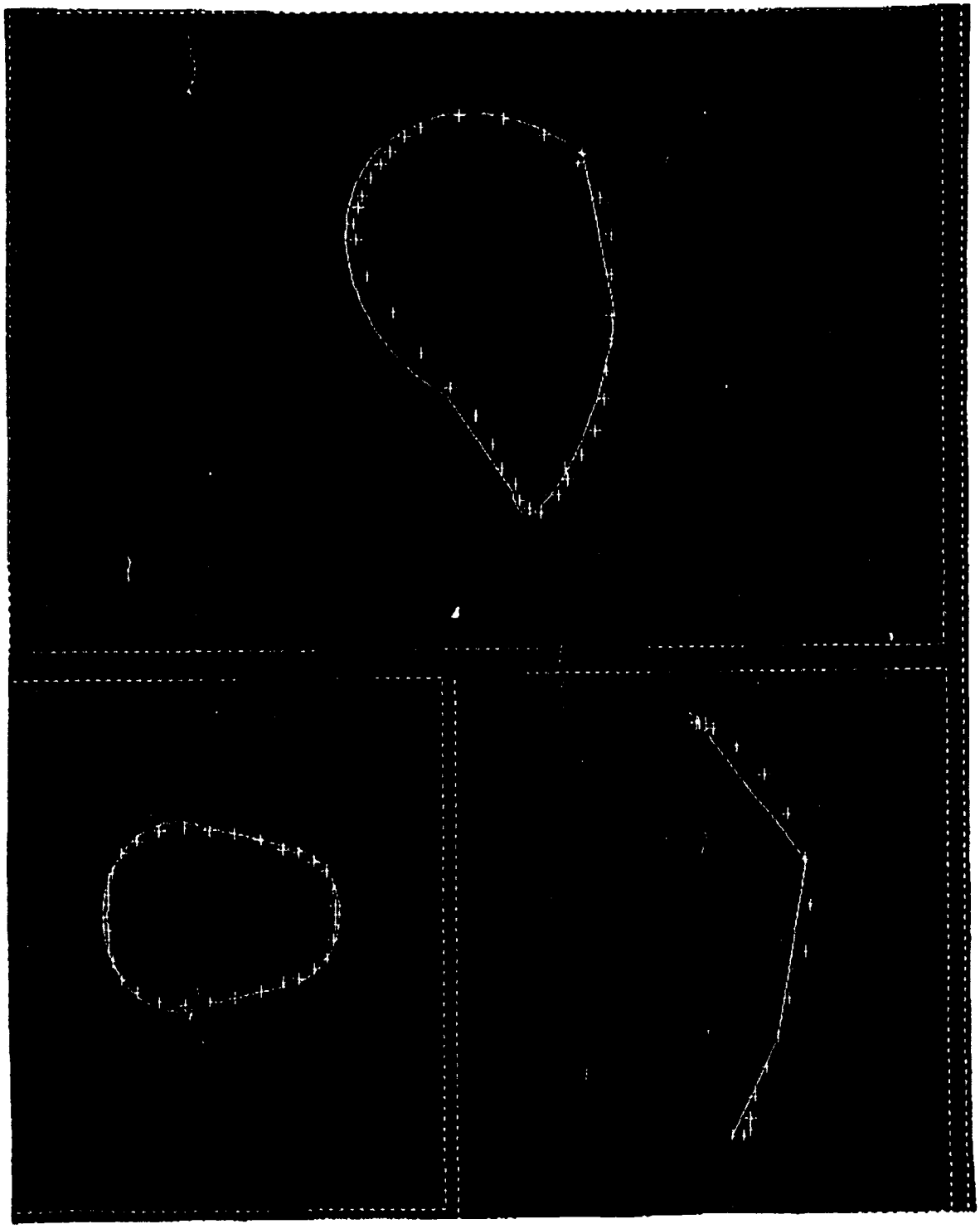


FIGURE 2. THREE-DIMENSIONAL COMPUTER MODEL OF A MASK SEAL CONTACT AREA FROM CRDEC

wearer. Encapsulated gels have come into vogue recently and are used in the sports industry to reduce shock, vibration, and provide a conforming interface. Most notably, gels have been used in bicycle seats and handlebar pads. Pneumatic bladders have also made an impact on the sportswear industry. Pneumatic bladders have been installed in the ankle area of some athletic shoes used to provide a conforming fit. Figure 3 shows a pneumatic bladder that was used in an athletic shoe made by Reebok. An example of a combination-type seal can be found on a pair of ear cushions designed for use in an aviation headset made by Bose. These ear cushions have a compliant elastomeric gel encapsulated inside a thin, pliable membrane. The gel is backed with a layer of slow recovery foam, which provides mechanical support for the gel and helps to maintain the shape of the ear cushion. The Bose ear cushion conforms to the irregular surface of the human head surrounding the ear and thus provides excellent noise isolation. Figure 4 demonstrates the compliant nature of the Bose ear cushion.

Generate Concepts

After identifying and reviewing the seals used for similar type applications, we proceeded to generate concepts that addressed the specific needs of the seals for RESPO 21. In order to generate concepts for seals it was necessary to define precisely as possible the area that the seal would contact around the face. A prototype hardshell mask was supplied by CRDEC to help visualize the seal area (see Figure 5). The prototype hardshell mask was thermoformed from an acrylic/poly vinyl chloride (PVC) alloy called Kydex 100. The mask was thermoformed over a plaster mold that was hand sculpted and thus, due to the mold and the fabrication process, the shape of the mask is not dimensionally accurate. However, the prototype hardshell mask provided a model on which to base our seal design.

Using the mask as a guide, we determined that the seal should provide a conforming, compliant interface between the mask and the mask wearer. One of the materials that provided these characteristics was silicone gel. The silicone gel we used was made by Dow Corning and referred to as Sylgard 527 primerless silicone dielectric gel. This silicone gel is a two-component type and designed to seal, protect, and preserve the electrical characteristics of delicate electronic circuits in severe environments. When

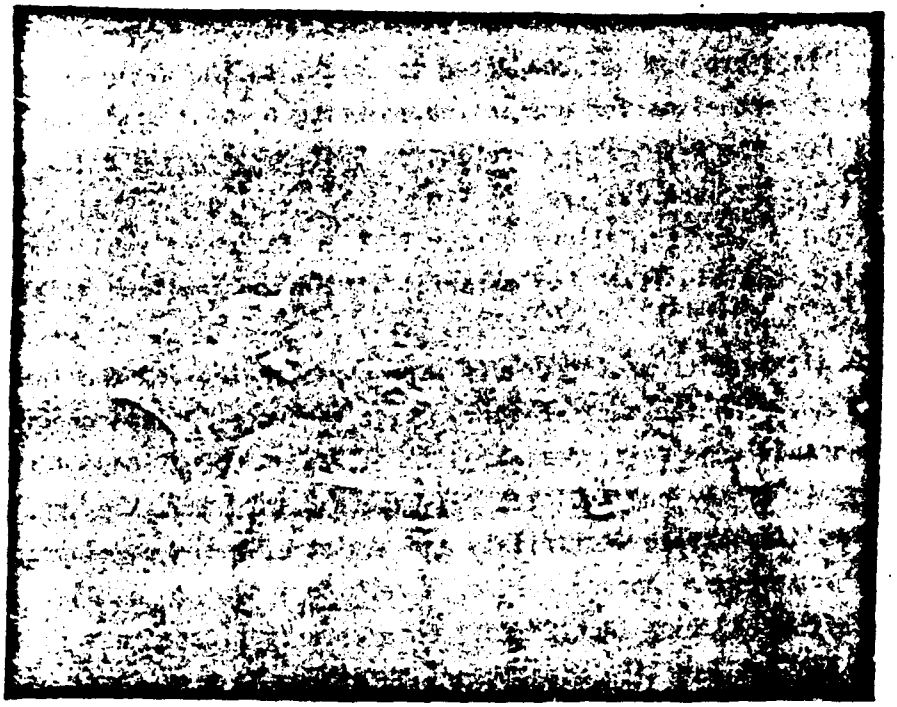


FIGURE 3. PNEUMATIC BLADDER FOR ATHLETIC SHOE

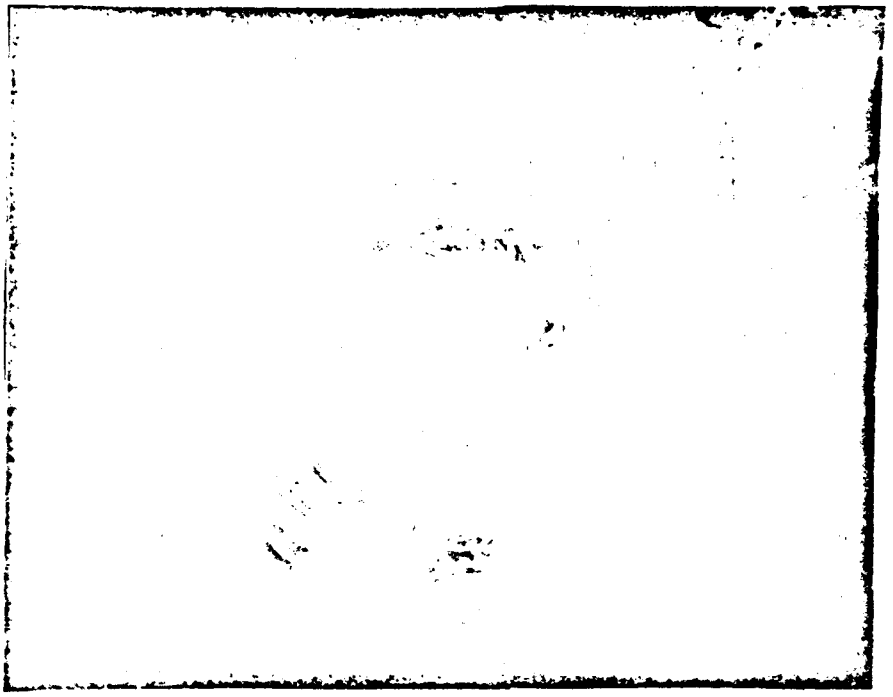


FIGURE 4. COMPLIANT 'GEL-FILLED' EAR CUSHION

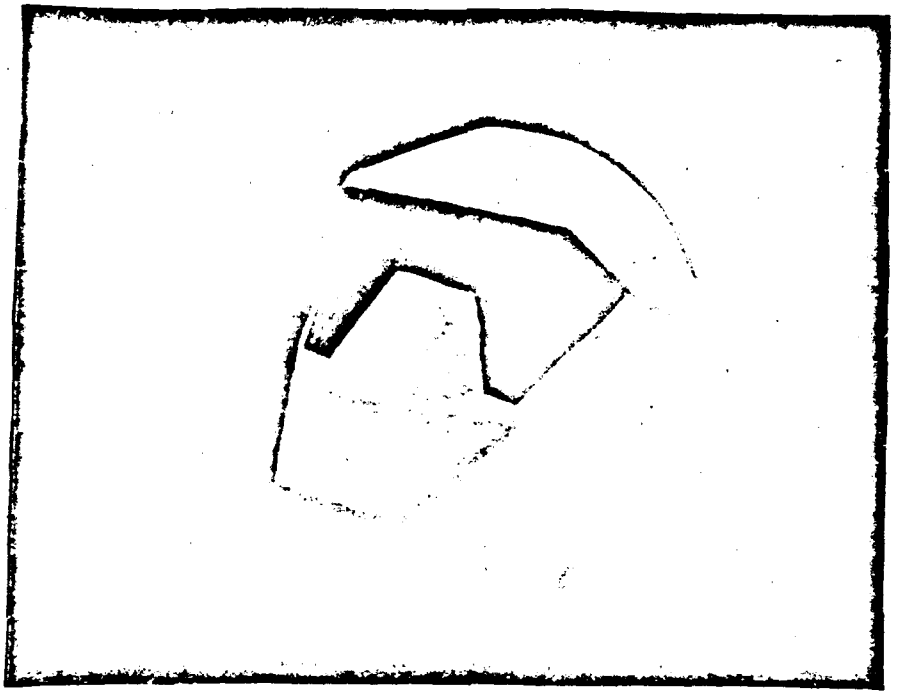


FIGURE 5. PROTOTYPE HARDSHELL MASK
SUPPLIED BY CRDEC

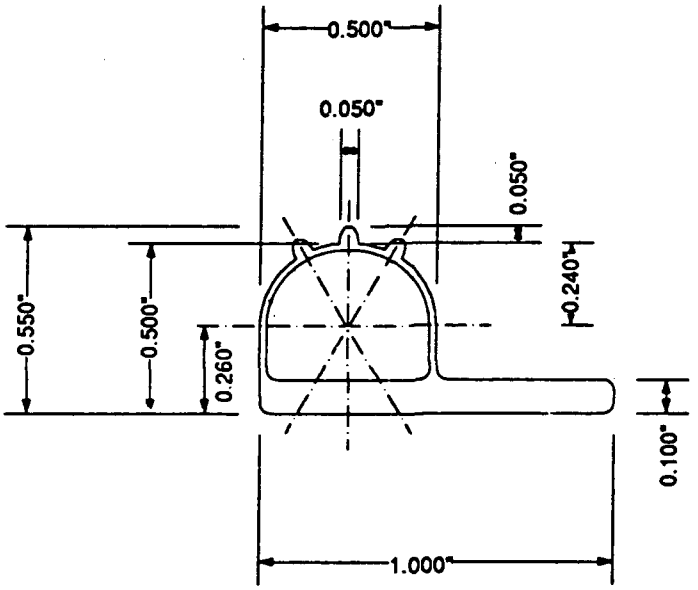


FIGURE 6. CROSS-SECTION OF GEL-TYPE SEAL

- Build-up seal flange with reinforcement material (chiffon) brushing layers of MDX 4-421C between layers of chiffon
- Heat cure approximately 60 minutes at 75 C
- Trim flash from seal

After fabricating the prototype gel-type seal, we proceeded to install the seal into the hardshell mask to evaluate the seal. The seal fit was a compromise at best. The prototype seal tended to buckle and wrinkle at the corners and radii inside the hardshell mask. Despite the poor fit due to geometrical discrepancies, the seal materials appear to exhibit the desired seal characteristics, i.e. compliancy and ruggedness. In order to make the seal match the geometry inside the hardshell mask, it became necessary to develop a technique to fabricate a contoured three-dimensional seal that would match the shape of the mask.

The shape of the contoured three-dimensional seal was based on the geometry of the inside of the hardshell mask, i.e. the surface onto which the seal will be mounted. This surface resembles in shape the edge of a potato chip. In order to fit a seal to this "potato chip" geometry, it became necessary to employ laser scanning and rapid prototyping techniques to develop a working model of the desired seal.

Laser scanning was used to scan the surface inside the hardshell mask onto which the seal is to be mounted. The laser scan defines discrete points that make up this surface and stores them as data. The next step was to connect these points to define a surface that describes the back of the seal. The cross-section of the seal was entered into the computer and swept along the back surface of the seal, thus forming a computer model of the three-dimensional contoured seal. This computer model was used to develop a hard plastic prototype using a process called stereolithography. The hard plastic prototype would be used to generate a mold which would be used for fabricating the gel-type seal. The advantage of this process over hand-sculpting is that changes can be made to the computer model and a prototype can be easily fabricated using stereolithography.

A hard plastic seal model was fabricated demonstrating the above process. The laser scan, computer model, and prototyping was conducted under another task for CRDEC, Contract Number DLA900-86-C-2045, Task 199, Evaluation of Component Prototyping and Reverse Engineering Systems. Photographs of the

hard plastic seal model and accompanying hardshell mask are shown in Figures 7 and 8.

Besides the gel-type seal, another approach was investigated for use as the seal. This approach used a pneumatic bladder to help maintain contact between the mask and the mask wearer. Donzis Research of Houston, Texas, fabricated a seal mock-up of the pneumatic type. Donzis used their patented technique of shaping the seal from a piece of foam, positioning a small pump and release valve on the foam, and dipping the foam/valve/pump assembly into an urethane solution, thus forming an airtight casing for the pneumatic seal. This approach lends itself to design flexibility by allowing control of the seal resilience and compliancy by selecting foams of various densities, and utilizing urethane coatings of various thicknesses and compositions. A copy of the Donzis patent is included in Appendix B of this report. Figures 9 and 10 shows a prototype of the pneumatic seal with pump and release valve. A sample cross-section of the seal material is shown in the upper left corner of Figure 9.

Establish Attachment Design Characteristics

In association with the seal design and development is the challenge of attaching these seals into the masks. The same basic characteristics apply to the development of attachment methods as applied to seal design. These characteristics are that the attachment mechanism should not protrude significantly from the inside or outside of the mask. The attachment mechanism should be capable of securing several layers of various materials and various thicknesses. The attachment mechanism should facilitate seal replacement and should be flexible to accommodate various mask designs and seal configurations.

Review Existing Attachment Methods

As with the seal development, we found it advantageous to review existing technology to determine if techniques currently in practice would be appropriate for our specific needs. The attachment methods reviewed include snap-fits, used for securing rigid plastic lenses into compliant rubber ski masks; interlocking fits, employed by several fastener companies; rivets and

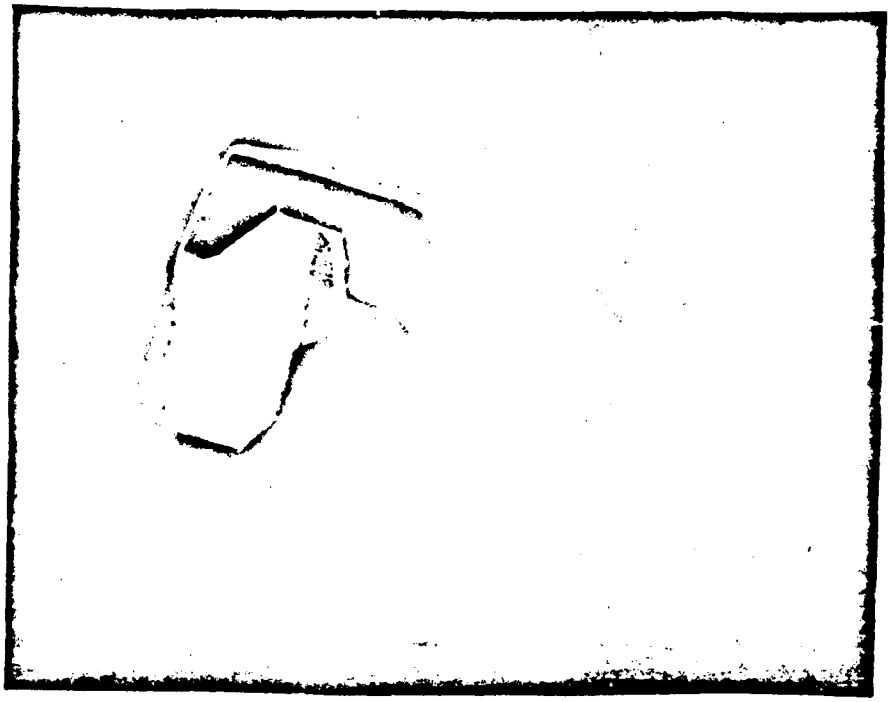


FIGURE 7. HARD PLASTIC SEAL MODEL AND PROTOTYPE HARDSHELL MASK

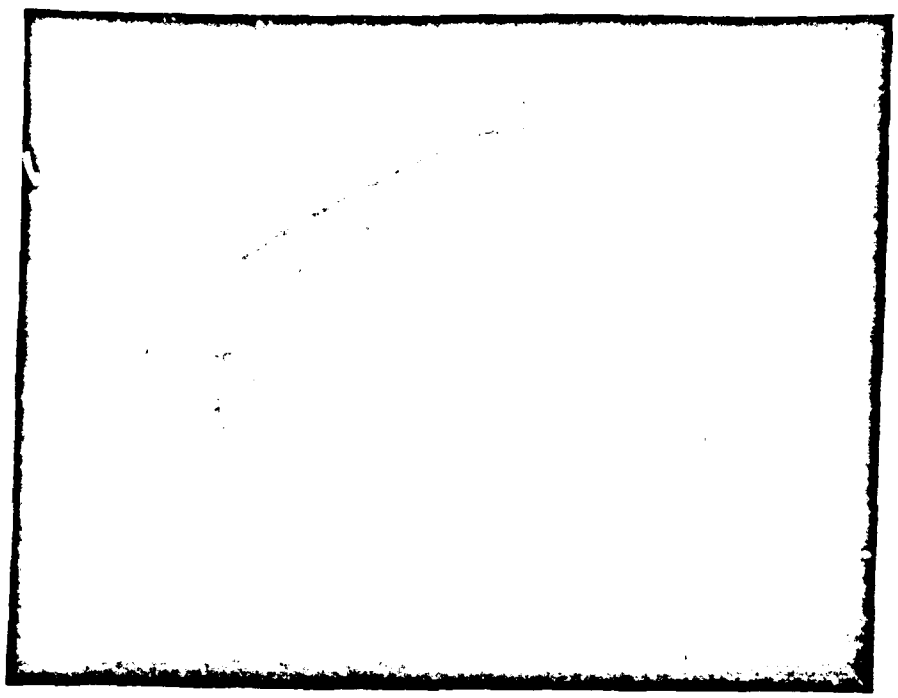


FIGURE 8. VIEW SHOWING FIT OF HARD PLASTIC SEAL MODEL INTO PROTOTYPE HARDSHELL MASK

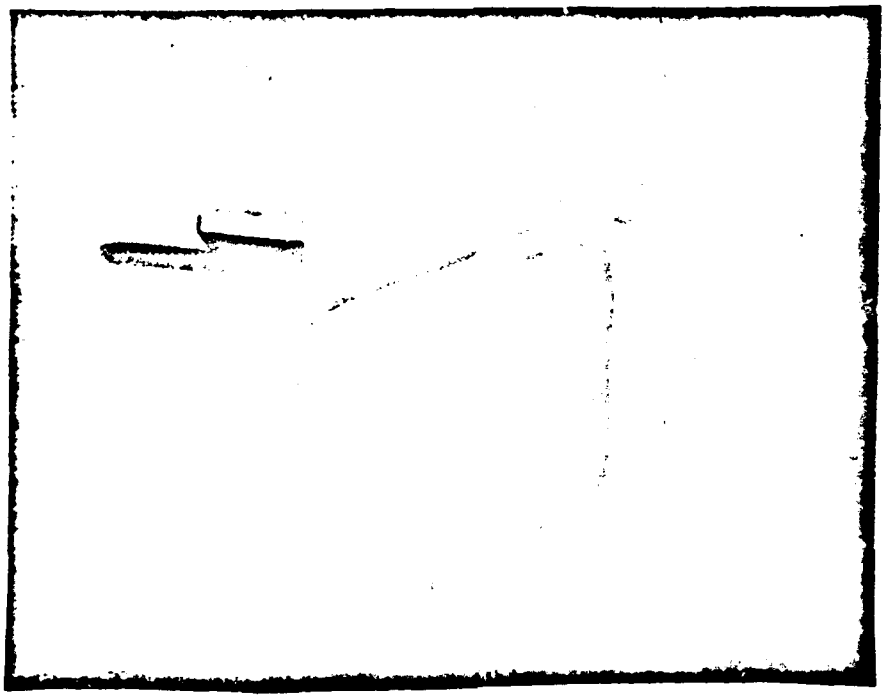


FIGURE 9. PROTOTYPE PNEUMATIC SEAL WITH PUMP AND RELEASE VALVE

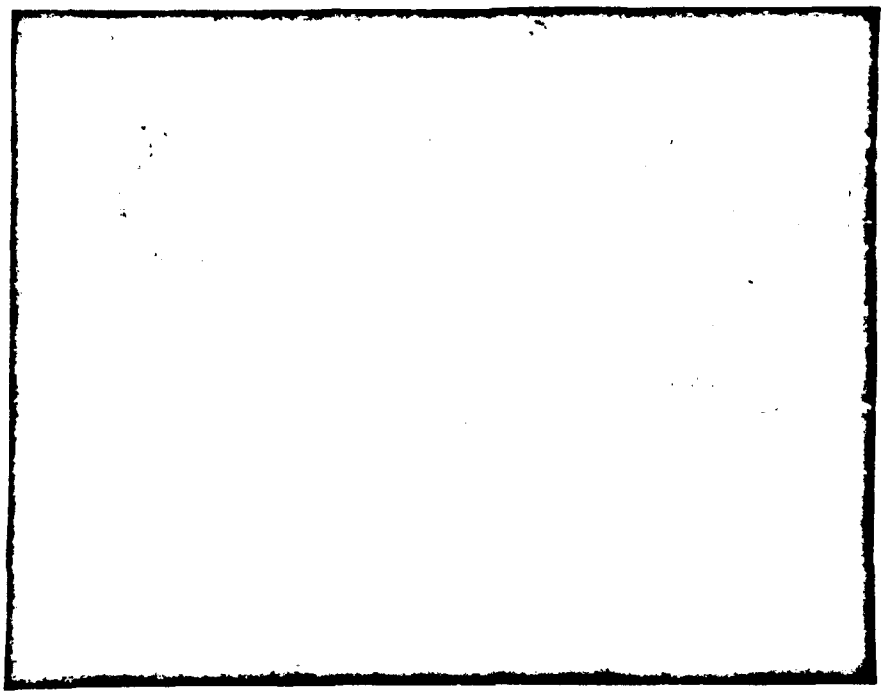


FIGURE 10. CLOSE-UP SHOWING COMPLIANCE OF PROTOTYPE PNEUMATIC SEAL

machine screws for semi-permanent attachment; clips such as those used for binding documents together; a wide choice of adhesives depending on the materials and cohesion desired; zippers, used in wet suits for sealing; velcro or hook and pile fasteners, used everywhere; and sealing, such as by heat, induction, ultrasonic, etc.

Generate Concepts

Early in the program we generated concepts in the area of mask attachment. That is, what methods are available to attach a hardshell-type mask to a person and maintain an effective seal for respiratory protection. Ten concepts for hardshell mask attachment were generated and presented to the client for review. Drawings of these concepts are included in Appendix C of this report. After reviewing the concepts, the client redirected the concept generation effort to attachment of seals to masks, both softshell and hardshell.

Two basic conceptual approaches were identified for attaching seals into masks. One approach utilizes discrete fasteners to retain several layers of material together yet still enable the user to replace the seal if necessary. This approach, illustrated in Figure 11, is intended for use on the multi-layer softshell mask. The second approach is intended for use with attaching a seal to a hardshell mask. This second approach utilizes a snap-fit ring that captures the seal around the perimeter of the mask (see Figure 12). This approach is considered to be a continuous attachment method. Both of the above described attachment methods place the seal between the mask wearer's face and the facepiece, thus sealing the area surrounding the face. The attachment means is located on the outside of the seal area, and thus small leaks in and around the attachment means do not decrease the protection of the mask wearer.

Development/Fabricate Prototype Attachment Mechanisms

In order to demonstrate the proposed attachment mechanisms it became necessary to obtain the materials that were desired to be attached together in their approximate configurations, that is, shaped like a seal and mask. Since development of the mask and seal are currently under development, we were

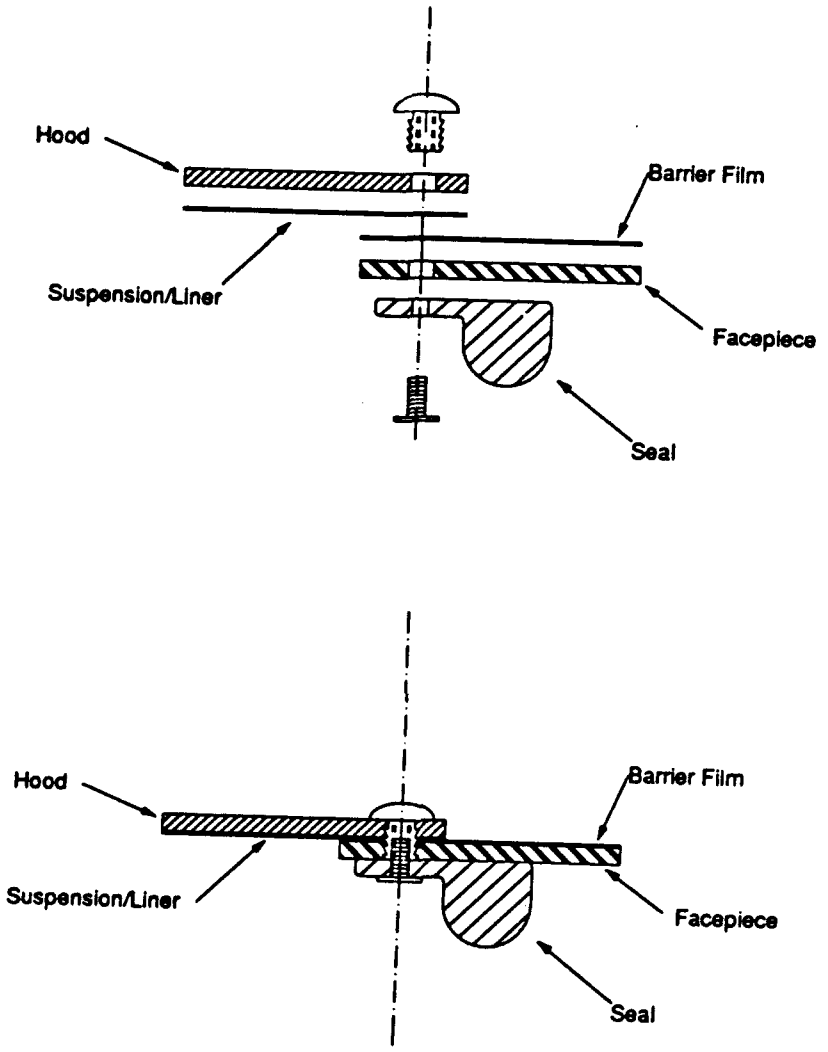


FIGURE 11. SEAL ATTACHMENT CONCEPT FOR SOFT SHELL MASK

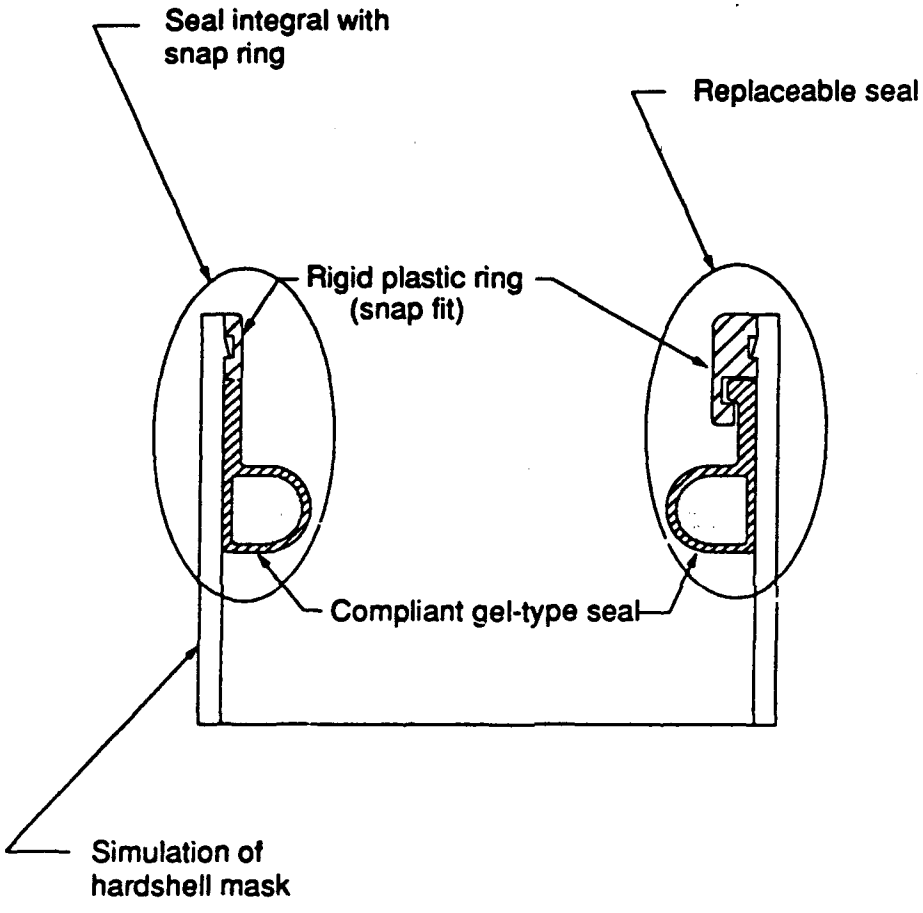


FIGURE 12. SEAL ATTACHMENT CONCEPT FOR HARDSHELL MASK

unable to obtain pertinent samples to demonstrate feasibility of the proposed attachment mechanisms. Therefore, we consider this phase of the program to be a feasibility study of various attachment mechanisms that apply to seal attachment to masks. We also intend for the content of this report to provide a design strategy for consideration during further development of attachment mechanisms for the mask and seals.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this program are twofold: First, it is feasible to develop a seal that conforms to the area surrounding the face. Second, it is possible that the developed seal could be attached to a mask by a variety of techniques. Materials exist that would facilitate design of such a seal and fabrication techniques are available to realize these designs in both prototyping and manufacturing modes. The seal could incorporate either separately or in combination compliant gels, foams, and pneumatic bladders to conform to the area surrounding the human face. The attachment mechanism could be on the exterior side of the seal, thus allowing the seal to seat between the face and the mask.

It is recommended that future work be conducted in the area of seals and attachment mechanisms for the respiratory protection system (RESPO 21). Further design and development is needed to specify a desired system or systems that would provide decided advantages with regard to improved protection, conformability, and mechanical isolation. The materials and fabrication techniques described in this report are available to assemble working prototypes of seal designs and attachment mechanisms for both hardshell and softshell masks. It is recommended that these seals be fabricated and attached to sample masks for further evaluation. If sample masks or demonstrator models do not exist, it is recommended that these be developed with the seal and attachment mechanisms in mind. The availability of sample masks will help facilitate the development of mask seals and attachment mechanisms.

APPENDIX A

LIST OF PATENTS - VENDORS

Patents

Title	Date	Patent #
RIFLEMAN'S GAS MASK	1966	3,249,106
ADJUSTABLE HELMET FACE MASK	1972	3,658,054
FULL VIEW DIVER'S MASK	1972	3,671,976
FULL VIEW DIVER'S MASK	1973	3,725,953
REMOVABLE GOGGLES FOR HELMET	1974	3,783,452
INTERGRATED HELMET AND MASK STRUCTURE	1974	3,833,936
NON-FOGGING FACE SHIELD	1974	3,838,466
HEADGEAR WITH AUTOMATIC SIZING MEANS	1975	3,866,243
TEAR-AWAY FACE MASK SUBASSEMBLY FOR FOOTBALL HELMETS	1975	3,889,296
INTERGRATED HELMET AND MASK STRUCTURE	1975	3,910,269
DUST-PROOF PROTECTION MASK OF FACE COVERING TYPE	1977	4,011,865
PROTECTIVE HELMET AND FULL FACE MASK CONSTRUCTION	1978	4,083,065
HEAD GUARD ASSEMBLY COMPRISING A PROTECTIVE HELMET AND A PROTECTIVE BREATHING M	1979	4,136,403
ANTI-FOGGING SPORTS GOGGLE	1979	4,150,443
DISPLAY CARRYING AND PROTECTIVE HELMET	1979	4,156,292
FACE MASK SEAL	1979	4,167,185
MASK FOR SKIN DIVING	1979	4,171,543
FACEMASK	1979	4,173,220
PROTECTIVE HEADGEAR	1980	4,233,687
DIVER'S HELMET AND FACE MASK FOR USE THEREWITH	1981	4,250,877
DISPOSABLE FULL-FACE SURGICAL MASK	1981	4,296,746

(j) said second parting surfaces having cooperative detent means adjacent said forward end of said shorter section and operable upon the lateral registration of said shank sections for locking said jaws in a closed position,

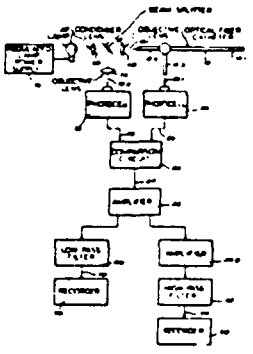
(k) said detent means including a projection from one of said second parting surfaces and a complementary recess in the other thereof which interlocks with said projection when said sections are in register with one another.

3,249,105

DEVICES FOR MEASURING BLOOD PRESSURE

Michael L. Polanyi, Webster, Mass., assignor to American Optical Company, Southbridge, Mass., a voluntary association of Massachusetts

Filed Apr. 19, 1963, Ser. No. 274,212
7 Claims. (Cl. 128—2.05)



1. A remote pressure transducer apparatus comprising a light-reflecting diaphragm, means supporting the diaphragm for exposing only one side thereof to a fluid pressure, said supporting means permitting displacement of the diaphragm on the supporting means in response to said pressure, said diaphragm having a selected elasticity such that said diaphragm can be displaced by said pressure to an extent which is proportional to said pressure, a light source located remotely from said diaphragm, light-conducting optical fiber means conducting light from said source and directing said light onto the opposite side of the diaphragm for reflecting a proportional part of said light therefrom toward a first station in accordance with said displacement of the diaphragm, light-conducting optical fiber means conducting said reflected light from said first station to a second station located remotely from said diaphragm, and photoelectric means responsive to said reflected light conducted to said second station for providing an electrical signal corresponding to said fluid pressure.

3,249,106

RIFLEMAN'S GAS MASK

Armand V. Motsinger, Aberdeen, Md., assignor to the United States of America as represented by the Secretary of the Army

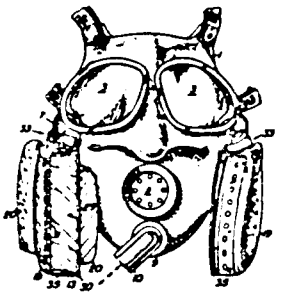
Filed July 29, 1963, Ser. No. 298,508
4 Claims. (Cl. 128—141)

1. A protective gas mask having particular use during the firing of a rifle, having in combination:

(a) Facepiece means having eyepiece means and integral flexible inlet tube means communicating with said eyepiece means and extending outwardly from said facepiece means;

(b) Head harness means to hold said facepiece means in engagement with the face of the wearer;

(c) Flexible canister retainer dependingly mounted on each exterior end of said tube means laterally of said facepiece means and having an inperforate outer wall and an inner perforate wall, whereby said canister retainer means may swing away from the side of said facepiece means, and whereby a rifle stock



can be inserted between said canister retainer means and said facepiece means for the accurate firing of said rifle during the use of said mask;

(d) Supporting means for said retainer means attached to said facepiece means and to said retainer means; and

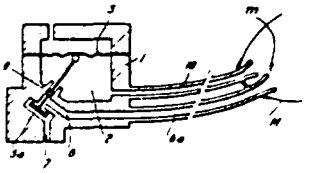
(e) Canister means operatively mounted in said canister retainer means.

3,249,107

OXYGEN REGULATORS FOR RESPIRATORY EQUIPMENT UNITS

René Gaston Delest, Meudon, Seine et Oise, France, assignor to Intertechnique, Plaisir, Seine et Oise, France, a French company

Filed Mar. 31, 1964, Ser. No. 356,292
Claims priority, application France, Apr. 4, 1963, 930,430, Patent 1,361,969
2 Claims. (Cl. 128—142)



1. In a respiratory apparatus of the type comprising: an oxygen regulator which has a controlled-delivery valve for regulating the oxygen flow and which is connectable to an oxygen source; a cavity formed within the regulator and constituted by a compartment and an overpressure chamber separated from each other by a flexible membrane operatively connected with said valve so as to effect the closure and the opening of said valve; pressure relief means comprising an overpressure safety valve for connecting said overpressure chamber with the atmosphere, and an auxiliary valve controlled by an aneroid capsule for connecting the overpressure chamber with the atmosphere; a breathing mask; a supply pipe for connecting said mask to the outlet of said valve; and an auxiliary conduit positively connected to said mask and to the said compartment, on one side of the membrane;

the provision of a compensating conduit positively connected to the mask and to the overpressure chamber on the other side of the membrane, and a conduit connected between the upstream side of the valve and the compensating conduit.

PATENTS

GRANTED JUNE 27, 1972

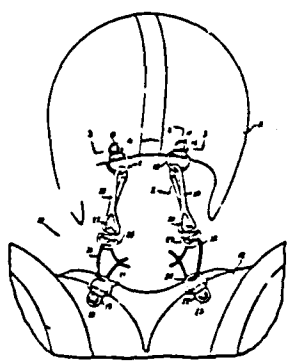
GENERAL AND MECHANICAL

3,671,974

FOOTBALL TRAINING HARNESS

Don D. Sims, P.O. Box 636, Throckmorton, Tex.

Filed Sept. 4, 1970, Ser. No. 69,788
Int. Cl. A42b
U.S. Cl. 2—3 R 1 Claim



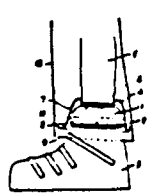
A football training harness in which detachable rigid connections adjustable in length extend from the shoulder pads to the rear of the football helmet to prevent hyperflexion and the bending of the head of the player forwardly during blocking and tackling. The connection includes rings secured to the helmet and shoulder pads and swivel snap hooks connected to the shoulder pad rings by means of a wire so as to be adjustable in length, with the snap hooks snaping into the rings fastened to the helmet.

3,671,975

SKI PANTS

Werner Vorsteher, Enzesfeld, N.O., Austria, assignor to Anba Sportmode Vorsteher KG, Wien, Austria

Filed June 24, 1970, Ser. No. 49,334
Claims priority, application Austria, Jan. 16, 1970, 425/70
Int. Cl. A41d 1/08
U.S. Cl. 2—232 2 Claims



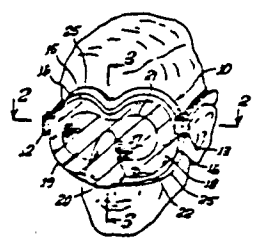
Each trouser leg of a ski pants type of garment is provided with a combined windbreak and cuff which provides for improved appearance, wind and snow protection, and flexibility in the area where the trouser legs overlap ski boots. Each windbreak is attached to a lower inside portion of a trouser leg and to an upper band of the cuff. The cuff includes upper and lower bands which limit up and down movements of the cuff when it is in an enclosing position over the top portion of a ski boot.

3,671,976

FULL VIEW DIVER'S MASK

Clarence S. Johnson, 4444 West Point Loma Boulevard, San Diego, Calif., and Larry E. McKinley, P. O. Box 647C, Camino Verde Road, Escondido, Calif.

Filed Oct. 15, 1970, Ser. No. 81,032
Int. Cl. A61f 9/02
U.S. Cl. 2—14 C 4 Claims



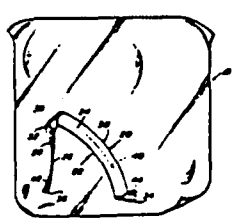
A full view diver's mask having a transparent faceplate member configured to conform to the general contour of a diver's face, carries a peripheral, resilient seal to maintain a sealed relationship. A frontal planar section and a pair of curved portions permit distortion-free frontal and peripheral vision.

3,671,977

HEADDRESS WITH IMPROVED HEAD ENCIRCLING BAND

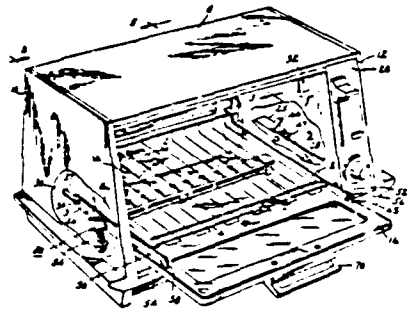
Julia S. Degnon, 175-39 Dalny Road, Jamaica Estates, N.Y.

Filed May 21, 1970, Ser. No. 39,304
Int. Cl. A42b 5/00
U.S. Cl. 2—207 1 Claim



A headdress characterized by two component parts, namely, a head encircling band and strap and a complementary overlying covering scarf which has a restricted portion stitched or otherwise attached to a median top portion of the band. The band is made up of inelastic and elastic portions with separable and connectible ends provided with quick-separable fasteners. The scarf is made of attractive fabric, is retained in place solely by the band and has loose free flowing ends which can be arranged at will to achieve an eye-pleasing effect.

toaster oven door to be automatically partially opened at the end of a cooking cycle, and wherein the door stop



mechanism also permits full manual opening of the door against the force of a spring.

3,658,051

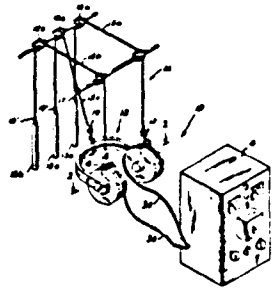
METHOD OF TREATING LIVING THINGS USING HIGH INTENSITY PULSED MAGNETIC FIELD

Kenneth Sheldon MacLean, 135 East 65th Street, New York, N.Y.

Continuation-in-part of application Ser. No. 547,125, Mar. 31, 1966, now abandoned, which is a continuation-in-part of application Ser. No. 301,108, Aug. 9, 1963, now abandoned, which is a continuation-in-part of application Ser. No. 794,492, Feb. 20, 1959, now abandoned. This application Nov. 13, 1967, Ser. No. 682,110

Int. Cl. A61b 17/52

U.S. Cl. 128—1.5 4 Claims



A method of treatment including positioning the part of the patient or animal to be treated between the poles of an electromagnet. The part is then subjected to a pulsating magnetic field induced in the electromagnet by an intermittent direct current, the peak intensity of each pulse being at least 3,000 gauss. Preferably each pulse has a duration of at least ¼ second, and about one pulse per ¼ second is administered.

3,658,052

BREATHING ACTIVITY MONITORING AND ALARM DEVICE

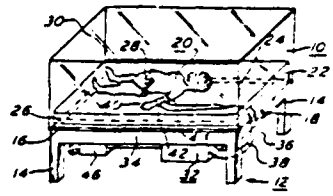
Albert R. Alter, Cheltenham, Pa., assignor to American Electronic Laboratories, Inc., Colmar, Pa.

Filed June 16, 1970, Ser. No. 46,610

Int. Cl. A61b 5/05

U.S. Cl. 128—2 7 Claims

An activity detecting means for detecting the movement of an animate object which includes a permanent magnet attached to the object. A pickup coil is provided around the area of movement of the object so that movements of the magnet induce a voltage in the coil. The output of the coil is delivered to circuit means which generates pulses when receiving the signal from the coil. An alarm means is



operated by the pulses to provide an alarm signal which flashes off and on with each pulse received, but remains on when no pulse is received. Thus, the alarm means indicates the movement of the object by the flashing signal and indicates no movement by a continuous signal.

3,658,053

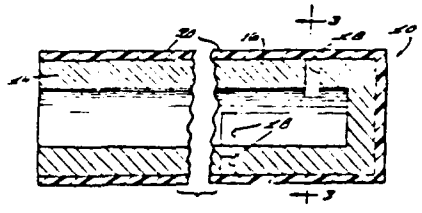
CATHETER FOR USE IN DETECTING DISSOLVED GAS IN FLUIDS SUCH AS BLOOD

Gordon J. Fergusson, Lutherville, Md., and Austin L. Wahrhaftig, Salt Lake City, Utah, assignors to Scientific Research Instruments Corporation, Baltimore, Md.

Filed Aug. 28, 1969, Ser. No. 853,784

Int. Cl. A61b 05/00

U.S. Cl. 128—2 G 11 Claims



A blood catheter including a cannula covered with a thin layer of silicone rubber or other material permeable to one or more of the gases that are or might be found in blood and wherein the cannula preferably includes a helical arrangement of apertures for enabling the diffusion of gas through the membrane and into the center portion of the cannula. The helical pattern of apertures around the periphery of the cannula enables the catheter to contact the interior wall of a blood vessel without restricting blood flow past more than a small fraction of the total number of apertures. Other hole configurations can be used, for example, when a plurality of holes are located at spaced axial locations along the cannula and at spaced intervals around the circumference of the cannula at the various axial locations.

3,658,054

ADJUSTABLE HELMET FACE MASK

Arthur S. Iberall, Radnor, Pa., assignor to General Technical Services, Incorporated, Upper Darby, Pa.

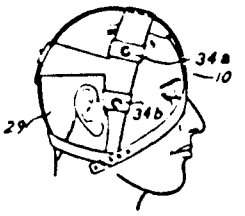
Filed May 11, 1970, Ser. No. 36,281

Int. Cl. A61b 5/02, 5/04

U.S. Cl. 128—2.05 R 1 Claim

An adjustable helmet for mounting physiological sensors employed to take physiological measurements of patient. The

adjustable helmet consists of a front portion of flexible plastic material having three flexible arms adapted to fit over the cheekbones and forehead of the wearer. The ends of each of the flexible arms are provided with a number of slots for adjusting the front portion to a particular person's head.



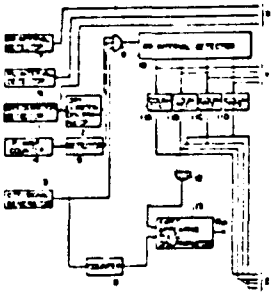
The rear portion of the adjustable helmet, also of flexible plastic, fits snugly over the back of the wearer's head and contains fasteners which snap into any of the slots in the flexible arms. Both the front and rear portions contain grommets for mounting physiological sensors in positions where the physiological measurement is to be made.

3,658,055

AUTOMATIC ARRHYTHMIA DIAGNOSING SYSTEM

Zenmon Abe; Takaji Suzuki; Masayuki Tsuneoka, all of Kokubunji-shi; Eiichi Kimura, Tokyo; Teizo Akazome, Tokyo; Kanji Obayashi, Tokyo, and Gengo Kasai, Tokyo, all of Japan, assignors to Hitachi, Ltd., Tokyo, Japan

Filed Apr. 11, 1969, Ser. No. 815,291
Claims priority, application Japan, May 20, 1968, 43/33600
Int. Cl. A61b 5/04
U.S. Cl. 128—2.06 A 13 Claims



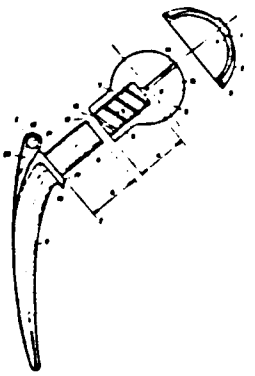
An automatic arrythmia diagnosing system for diagnosing heart disease employs a plurality of detector elements for detecting both the components and the time interval between components of the portions of an electrocardiagraph wave. The values of cardiac potentials which are detected during one cardiac cycle are compared with those of a later cardiac cycle when the frequency of the presence of the arrhythmia is high. The number of cardiac potentials of a cardiac cycle is averaged over a predetermined number during an earlier cardiac cycle when the frequency of the presence of arrhythmia is low. Digital logic circuitry is employed to be responsive to code signals representative of various portions of the electrocardiagraph signal to produce signals indicative of different forms of heart disease.

3,658,056

HIP JOINT PROSTHESIS

Arnold H. Huggler, Masanserstr. 168, 700 Chur, and Bernhard G. Weber, Gellertstr. 4, 9000 St. Gallen, both of Switzerland

Filed Apr. 21, 1969, Ser. No. 817,654
Claims priority, application Switzerland, Apr. 25, 1968, 6197/68
Int. Cl. A61f 1/24, 1/00
U.S. Cl. 128—92 CA 4 Claims



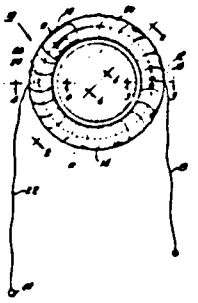
The shaft which is of metal is fitted with a spherical joint head of synthetic material while the socket is also of metal. The synthetic joint head is spaced slightly from a collar of the shaft to permit compressing of the joint head by the collar upon the occurrence of shock loadings. The joint head is lubricated through a channel at the upper end and through an internal spiral groove.

3,658,057

DIAPHRAGM

Hugo S. Cimber, 22 Seven Gables Road, Staten Island, N.Y.

Filed Nov. 4, 1969, Ser. No. 873,848
Int. Cl. A61f 5/46
U.S. Cl. 128—129 5 Claims



A self inflating diaphragm having an inner tube containing air or gas under pressure and an outer flexible tube, a plug removable by a string from the inner tube permits the air or gas from the inner tube to expand the outer tube to occlude the passage, an occluding membrane may be used across the inner tube to facilitate retention of fluids and for contraception. With or without the membrane the device may constitute a supporting structure.

PATENTS

GRANTED APRIL 10, 1973

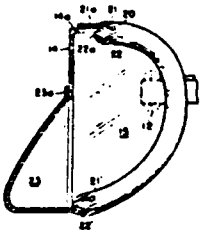
GENERAL AND MECHANICAL

3,725,953

FULL VIEW DIVER'S MASK

Clarence S. Johnson, and Arthur F. Langguth, both of San Diego, Calif., assignors to The United States of America as represented by the Secretary of the Navy

Filed Jan. 24, 1972, Ser. No. 220,026
Int. Cl. A61f 9/00
U.S. Cl. 2—14 W 3 Claims



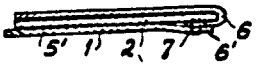
A face mask having a rigid transparent member defining a frontal portion and two curved side portions allows for wide-angle vision with little distortion. An outwardly bulging nose portion is provided to permit a close fitting on the face and to reduce the mask's entrained mass. A resilient seal formed with an annular cross-sectional configuration is fitted about the periphery of the transparent member to ensure a sealed fitting on a number of differently contoured faces by resiliently compensating for the dissimilar facial features. Including the disclosed seal minimizes discomfort when the mask is worn for prolonged periods of time since the seal does not dig into the fleshy portions of the face.

3,725,954

METHOD OF MANUFACTURING GARMENT COLLARS OR LAPELS

Walter Baldini, Via Raffaello Sanzio 2/A, Milan, Italy

Filed Sept. 15, 1970, Ser. No. 72,256
Int. Cl. A41b 3/00
U.S. Cl. 2—143 1 Claim



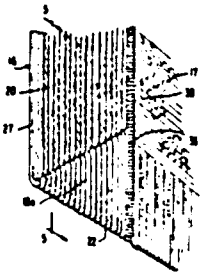
An intermediate textile article for the fabrication of garment collars or lapels is produced by thermally bonding a first layer of textile material in uninterrupted surface-to-surface contact to one side of an inner layer of bonding material and by thermally bonding a second layer of textile material to the other side of the inner layer, but only at several spaced locations. The bond between portions of the inner layer and the second textile layer is thereupon destroyed to allow for insertion of a portion of an upper collar which consists of cloth and is secured to the first and second textile layers by sewing. Those portions of the inner layer and the second textile layer which are not overlapped by the inserted portion of the upper collar are bonded to each other in uninterrupted surface-to-surface contact.

3,725,955

CONNECTION OF TUBULAR ELEMENT TO A GARMENT

Donald S. Grant, Des Plaines, Ill., assignor to The Merrow Machine Company, Hartford, Conn.

Filed Jan. 7, 1972, Ser. No. 216,008
Int. Cl. A41d 1/04; A41h 9/00
U.S. Cl. 2—90 10 Claims



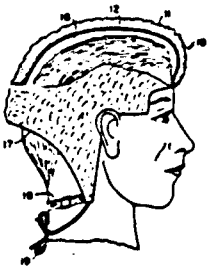
A tubular garment element has a front panel folded transversely upon itself and provided with a diagonally cut end which is attached to a diagonally cut end of a foreshortened rear panel. The tubular garment element is sewn to another garment element along a line of stitching which intersects the connected diagonal ends at a point spaced from the edge of the garment to reduce the difficulty of maintaining alignment between the garment elements during sewing.

3,725,956

LAMINATED HELMET

Dorothy Ann Carrier Reisen, 772 Greenfield Avenue, Pittsburgh, Pa.

Filed May 11, 1971, Ser. No. 142,163
Int. Cl. A42b 1/02
U.S. Cl. 2—200 3 Claims



The specification discloses a head covering in the form of a helmet of unique construction adapted for wear indoors by persons of either sex during leisure time or while sleeping. The helmet is multi-layered, with an outer layer of lambs wool, long-haired fur or other similar heat insulating material and an inner layer of woven fabric. The helmet is constructed so as to be supported at each side on the bridge of the wearer's nose and in front on the wearer's brow so as to provide an air space between the crown of the wearer's head and the inside of the helmet. The rear portion of the helmet has an essentially inverted V-shaped opening for ventilation of the space above

PATENTS

GRANTED JANUARY 8, 1974

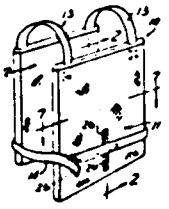
GENERAL AND MECHANICAL

3,783,449

BULLET-PROOF PROTECTIVE ARMOR AND METHOD OF MAKING SAME

Richard C. Davis, 8611 Whitehorn, Romulus, Mich.

Filed May 8, 1972, Ser. No. 251,077
Int. Cl. F41h *1/02*
U.S. Cl. 2—2.5 4 Claims



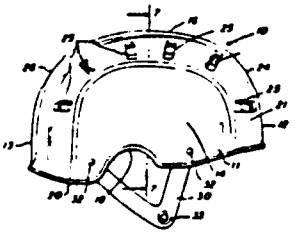
A bullet-proof armor formed of a pad made of a number of loose sheets woven of heavy gauge, linearly oriented nylon threads, the pad being enclosed within a cloth envelope, and means for holding the envelope containing the pad upon the object to be protected. The sheets are treated by subjecting them to super-cooling in a cryogenic atmosphere to thereby increase their impact resistance capabilities.

3,783,450

HOCKEY HELMET

William Raymond O'Connor, 2190 Sargent Ave., St. Paul, Minn.

Continuation of Ser. No. 216,633, Jan. 10, 1972, abandoned. This application Feb. 5, 1973, Ser. No. 329,320
Int. Cl. A42b *3/00*
2—3 R 12 Claims



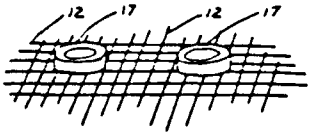
A hockey helmet is disclosed in which an outer shell is formed of lightweight material generally by injection molding with three protective ribs extending longitudinally over the top of the helmet, the two outer ribs having openings formed therein. The openings progressively decrease in area as they extend from the front to the back of the helmet. The inside of the helmet has three protective pads secured to the inside of the outer protective shell so that a pair of passages are formed in cooperation with the ribs in cooling the upper part of the head of the wearer. The central pad covers the central rib and forms an air cushion for the top of the head of the wearer.

3,783,451

INSECT PROTECTIVE GARMENT

Eugene F. Malin, 1040 Bayview Dr., Suite 201, Fort Lauderdale, Fla.

Continuation of Ser. No. 138,677, April 29, 1971, abandoned. This application Dec. 20, 1972, Ser. No. 316,676
Int. Cl. A42b *3/00*
U.S. Cl. 2—4 6 Claims



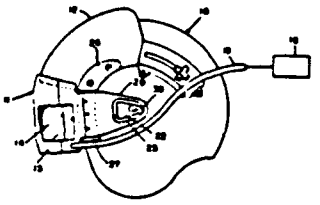
An insect protective garment for use in a warm climate comprising an insect netting material coupled to skin separating members such as, circular rings or elongated rib members which hold the netting material off the users skin to prevent mosquitoes from reaching or making contact with the skin of the wearer. Insects adjacent the net area are unable to reach the skin, while the garment provides sufficient air flow through the net and about the wearer's skin.

3,783,452

REMOVABLE GOGGLES FOR HELMET

Alden P. Benson; Kenneth J. Foster, both of Dedham, and Alfred R. Quellette, Saugus, all of Mass., assignors to the United States of America as represented by the Secretary of the Navy, Washington, D.C.

Filed Apr. 11, 1972, Ser. No. 242,999
Int. Cl. A42b *3/00*
U.S. Cl. 2—6 3 Claims



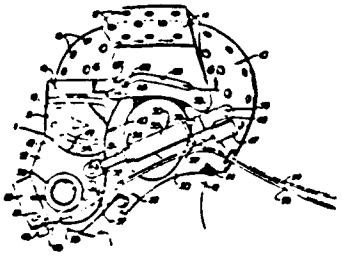
Apparatus for attaching removable photochromic goggles to a conventional crash helmet includes a post on one side of the helmet adjacent the face opening thereof and an over-center latch on the other side of the helmet which engages apexes of triangular eyelets formed in straps extending from the distal ends of the goggles. The over-center latch has a lever with a camming surface formed thereon, notched to retain the apex of one of the eyelets and pivoted such that upon turning of the lever aftwards the notch is moved aftwards, stretching the straps, within side brackets formed on the helmet for vertically locating the goggles in front of the wearer's eyes.

PATENTS

GRANTED SEPTEMBER 10, 1974

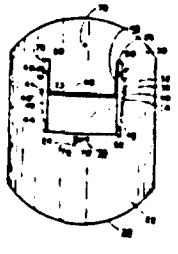
GENERAL AND MECHANICAL

3,833,935
INTEGRATED HELMET AND MASK STRUCTURE
[illegible] K. Ansite, Glendale, and John J. Mitchell, Jr., Arcadia, both of Calif., assignors to Sierra Engineering Company, Sierra Madre, Calif.
Filed May 22, 1972, Ser. No. 255,838
Int. Cl. A62b 7/00
U.S. Cl. 2—6 9 Claims



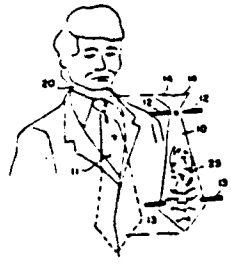
For flying personnel there is provided a hard shell helmet suitably padded and held out of close contact with the head. An integrated visor assembly has an articulated attachment to the helmet movable between an operative position over the wearer's face and a lifted position extending over the top of the helmet removed from the face. Compound leverage means making up the attachment determine a path of movement for the visor assembly such that it travels an irregular path allowing it to first lift clear of contact with the face and then travel upwardly to its lifted position. An inflatable seal extends around the perimeter of the visor assembly, the seal being inflated with air from the oxygen supply for the breathing mask when in operation over the face of the wearer and being collapsed when deflated providing additional clearance for ease of removal from the head and for storage in its lifted position.

3,833,936
WELDER'S MASK
[illegible] C. LoGuidice, 12525 N.W. 21 Pl., Miami, Fla. 33167
Filed Jan. 5, 1973, Ser. No. 321,433
Int. Cl. A61f 9/06
U.S. Cl. 2—8 4 Claims



An optically protective viewing glass is slidably mounted in [illegible] vertically fixed at the sides of a viewing slot in a face shield. The viewing glass is driven between opposite work performing and work viewing positions by a motor and synchronized side gear trains to prevent jamming of the glass in the slots. The motor is mounted on the face shield and energized from a power source, similarly mounted, through circuit means having two parallel branches, one branch energizing the motor to drive the viewing glass to one opposite positions, and the other branch to the other opposite positions. Limiting switches, respectively connected in the parallel branches and mounted on the face shield at respective opposite positions of the viewing glass, are operated by the viewing glass reaching either of said positions to open the limit switch in the parallel branch energized to drive the glass to the position just reached and simultaneously to close the limit switch in the other parallel branch. An energizing switch is mounted on the face shield and connected in the branch circuits to alternately close the circuit of one of the parallel branches and open the other as it is mouth-operated by a welder. The limiting and energizing switches are coordinated to alternately drive the viewing glass to opposite positions each time the energizing switch is operated.

3,833,937
NAPKIN FOR TIES
Kendrick Taylor, San Jose, Calif., assignor to The Raymond Lee Organization, Inc., New York, N.Y., a part interest
Filed Mar. 16, 1973, Ser. No. 342,036
Int. Cl. A41d 27/12
U.S. Cl. 2—46 1 Claim



An attachable protective napkin for a man's tie which may be readily fastened so as to protect the tie when being worn while eating from the splatter of food or other liquids. The device is a shaped section of laminated absorbent and waterproof paper or plastic sheeting. One end of the tie napkin is triangular shaped, so as to tuck about the tie and under the collar of the wearer, with the napkin shaped to the general outline of a man's tie and of slightly larger dimension and fitted with flexible semi-rigid tie members that bend about the protected tie so as to retain the napkin in position.

3,833,938
TURNOUT COAT
John David Shweid, San Francisco, Calif., assignor to John Morris Company, Inc., San Francisco, Calif.
Filed Aug. 10, 1973, Ser. No. 387,576
Int. Cl. A44b 19/32
U.S. Cl. 2—96 8 Claims

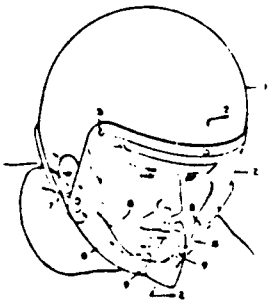
An efficient and effective means for connecting and sealing the front trunk and collar portions of a turnout coat is disclosed. One side of the coat front fits between two parallel flaps which form the other side of the coat front. Strips of en-

PATENTS

GRANTED OCTOBER 1, 1974

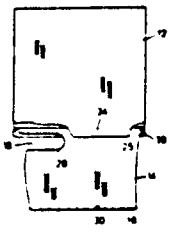
GENERAL AND MECHANICAL

3,838,466
NON-FOGGING FACE SHIELD
Reginald E. Poirier, Houlton, Maine, assignor to Stuart A. White, Island Falls, Maine, a part interest
Continuation-in-part of Ser. No. 327,211, Jan. 26, 1973, abandoned. This application Mar. 21, 1973, Ser. No. 343,523
Int. Cl. A61f 9/00
U.S. Cl. 2—10 2 Claims



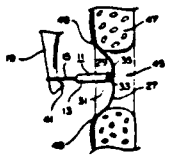
1. In a face shield, the improvement comprising a pair of aspirating exhaust ducts for the withdrawal of breath-laden air from the interior of said shield each of said exhaust ducts having an intake opening in or upon the inner surface of said shield generally in front of the wearer's nostrils and mouth, a confined passage extending substantially laterally from said intake opening to a discharge opening *located adjacent* an edge of said shield and an inner sidewall extending rearwardly beyond said discharge opening.

3,838,467
CAP AND ELASTIC FACE HOOD
Donald Zientara, Greendale, Wis., assignor to Zwicker Knitting Mills, Appleton, Wis.
Filed Nov. 1, 1972, Ser. No. 302,753The portion of the term of this patent subsequent to July 24, 1990, has been disclaimed.
Int. Cl. A42b 1/06
U.S. Cl. 2—202 5 Claims



1. A cap formed of an elongated tubular body of knitted material comprising a top cap portion and a face hood portion joined together along a line, said top cap portion and said face hood portion comprising different stitching whereby said face hood portion is more dense and elastic than said top cap portion, said face hood portion having an open lower end and at least one opening located between said line and said open lower end, said face hood portion being telescopable with said top cap portion, and an external roll formed by a first fold at the lower end of said top cap portion and a second fold at the upper end of said face hood portion whereby said line is disposed inwardly of said top cap portion and outwardly of said face portion, and elastic stitching extending through said cap along said line and through said first fold of said top cap portion for securing said face hood portion within said top cap portion and for securing said first and second folds together to form said roll and for maintaining said roll in position when said face hood portion is telescoped or extended.

3,838,468
PROSTHESIS AND MEMBRANE STRUCTURE TO REPLACE THE STAPES
Beverly W. Armstrong, Charlotte, N.C., assignor to Richards Manufacturing Company, Memphis, Tenn.
Filed Jan. 15, 1973, Ser. No. 323,940
Int. Cl. A61f 1/24
U.S. Cl. 3—1 7 Claims



1. In combination with membrane structure of a prosthesis for use in otological surgery to replace the stapes of the middle ear, said prosthesis comprising a proximal end including means for attachment to the incus, a distal end fixedly attached to said proximal end and including a pair of leg means straddling a bight portion of the membrane structure, said distal end being interrupted along a line extending transversely of said prosthesis to establish said pair of legs, portions of said pair of legs defining a pair of remotely disposed notches respectively leading into remote ends of said interruption for initially receiving and guidingly constraining the bight portion of the membrane structure and certain jig structure for subsequent entry into said interruption whereby said pair of legs may be spread apart to straddle the bight portion of the membrane structure.

3,838,469
UNDERMATTRESS
Johannes B. H. J. Rademaker, Winchoten, Netherlands, assignor to B.V. Rawi Fabrieken v/hC. Rademaker & Zoon Winschoten, Netherlands
Filed Jan. 22, 1973, Ser. No. 325,447
Claims priority, application Netherlands, June 30, 1972, 7209273
Int. Cl. A47c 19/00
U.S. Cl. 5—191 6 Claims

1. An undermattress consisting of a rigid frame of open rectangular construction and a plurality of rigid horizontal members extending between and joined to opposite sides of said frame in spaced relation to each other parallel with the ends of said frame whereby said open rectangular construction afforded by said frame is subdivided into a number of smaller open rectangular subframes, and a rigid mattress

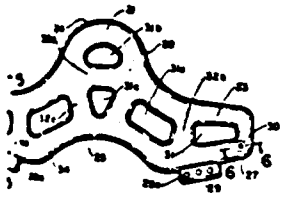
PATENTS

GRANTED FEBRUARY 18, 1975

GENERAL AND MECHANICAL

3,866,241
OULDER PAD CUSHION
: Bluebell Ave., 212 Vanderbuilt Tower II,
48
ov. 9, 1973, Ser. No. 414,347
Int. Cl. A41d *13/00*

6 Claims

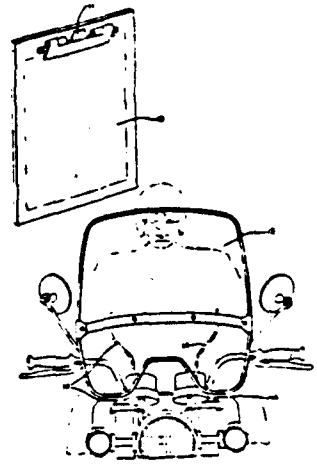


atable shoulder pad cushion for one shoul-
worn in readily detachable pairs for use
shoulder pads, said cushion comprising
ected, relatively thin, narrow inflatable
ymmetrical medial portion for extending
e fore and aft direction with respect to a
y over the top of one shoulder of the
portion having fore and aft, symmetrically
ensions for projecting over the chest and
; said extensions comprising part of said
being inwardly offset whereby inner edges
a pair of said cushions worn on the shoul-
disposed adjacent to each other; integrally
projecting from said inner edges for con-
ushions to each other at the extensions
g valve means provided at one point in
g.

3,866,242
ROTECTIVE SHIELD
oenix, Ariz., assignor to Goodyear Aero-
e, Ohio
t. 27, 1972, Ser. No. 301,544
nt. Cl. F41h *1/02, 5/12*

6 Claims

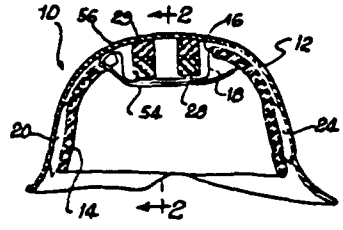
consisting essentially of an optically clear
ut one-fourth to three-fourth inch thick,
er of a shield and capable of stopping a
n metal projectile fired at 90° obliquity at
from the shield, said polyurethane com-
product of (a) a polyurethane prepolymer
r a polyether glycol or polyester glycol of
molecular weight with methylene bis(cy-
) in the equivalent ratio of 2.7 to 4.5 NCO
nd (b) an aromatic amine curing agent having a methylene bridge between two aromatic rings to achieve an equivalent ratio of 0.90 to 1.04 NH_2/1.0 NCO.



6. The safety shield of claim 1 wherein the shield has the contour of a face mask.

3,866,243
HEADGEAR WITH AUTOMATIC SIZING MEANS
Gerard E. Morgan, Lake Forest, Ill., assignor to Riddell Inc., Chicago, Ill.
Filed Oct. 15, 1973, Ser. No. 406,625
Int. Cl. A42b *3/02*
U.S. Cl. 2—3 R

28 Claims



1. In a headgear construction comprising a shell, and fitting means within the shell for engagement with the head of the wearer, the improvement wherein said fitting means comprises at least one chamber, a source of compressible fluid, means interconnecting said source and said chamber, said interconnecting means including a first means permitting passage of said fluid from said source to said chamber, and a second means permitting passage of said fluid from said chamber to said source, means engageable by the head of the

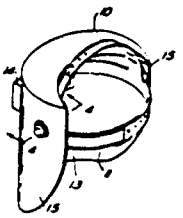
wearer upon placement of the headgear on the head operating to transfer said fluid through said first means from said source to said chamber whereby the dimensions of the head receiving space within the helmet will vary, and means for restricting operation of said second means upon placement of the headgear on the head to restrict passage of said fluid back to said source to thereby substantially maintain the variation in size change while the headgear is in place on the head.

3,866,244

HEADGEAR STRUCTURE FOR WELDING HELMETS AND THE LIKE

Heinz E. Ruck, Morton, Pa., assignor to The Fibre-Metal Products Co., Concordville, Pa.

Filed Nov. 8, 1973, Ser. No. 414,165
Int. Cl. A61f 9/00, A41d 13/00
U.S. Cl. 2—8 8 Claims



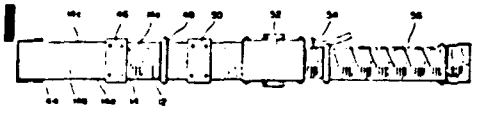
1. A headgear structure for supporting a welding helmet and comprising a headband for circumposition about a wearer's head, a bridge piece extending between spaced regions of said headband for extension across the wearer's head, a pair of elongate extensions located on opposite sides of said headband and each looped outwardly and upwardly with its terminal portion proximate to the adjacent region of said bridge piece, securing mens securing said terminal portions of said extensions to said bridge piece, and pivot mens extending through the outer portion of each looped extension for rotatively supporting a welding helmet, said headband and bridge piece and extensions being integrally fabricated of plastic, said securing means detachably securing said terminal portions to said bridge piece, said extensions being flexible to lie sustantially flat and coplanar with said headband and bridge piece in nonuse condition, said extensions each comprising an outstanding portion hingedly connected to a lower adjacent region of said headband, an upstanding portion hingedly connected to and upstanding from the outer extremity of said outstanding portion, and an inwardly extending portion hingedly connected to and extending inwardly from the upper extremity of said upstanding portion to said terminal portion.

3,866,245

PLASTIC GLOVES AND METHOD OF MAKING SAME

Donald Robinson Sutherland, 315 Forman Ave., Toronto, Ontario, Canada

Filed Dec. 22, 1972, Ser. No. 317,826
Int. Cl. B32b 31/18, A41d 19/00
U.S. Cl. 2—169 11 Claims



1. A method of manufacturing a glove comprising the steps of

a. forming a two-ply liner web consisting of a two-ply longitudinally extending portion and a plurality of two-ply hand shaped portions, each of said hand shaped portions having distinct finger portions and a cuff portion, each of said cuff portions being integral with said longitudinally extending portion, said portions project laterally from said longitudinally extending portion at spaced intervals along

b. interposing said two-ply liner web between films of thermoplastic material and overlapping films of thermoplastic material to form a seal line disposed outwardly from the hand shaped portion to form a laminate, and

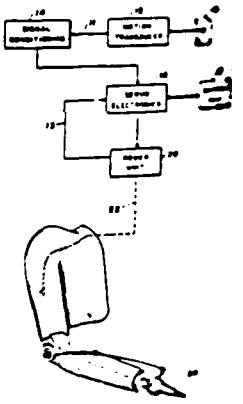
c. detaching individual lined gloves from said laminate by severing said films along a line outwardly from said seal line and by severing hand shaped portions of said liner from the extending portion thereof along a line remote from said cuff portion.

3,866,246

SHOULDER DISARTICULATION PROSTHESIS

Woodrow Seamone, Rockville, and Gerhard Nilson Island, both of Md., assignors to The United States of America as represented by the Secretary of the Army, Washington, D.C.

Filed Nov. 14, 1972, Ser. No. [illegible]
Int. Cl. A61f 1/00, 1/08
U.S. Cl. 3—1.1



1. A control system for actuating a prosthesis to simulate voluntary skin movement of a user, comprising

a prosthesis;

displacement sensing means for measuring the magnitude of movement of a point on the skin of a user of the prosthesis, the sensing means comprising

a magnet,

connecting means joined to the magnet and adapted to be connected to a point on such user's body at which

magnetic field sensitive means for sensing the magnetic field on displacement of the magnet from a position of that point on such user's body to which the connecting means is joined,

means for actuating said prosthesis in response to the sensed skin movement; and

means for providing a position feedback signal indicating means for identifying the degree of actuation imparted to said prosthesis.

PATENTS

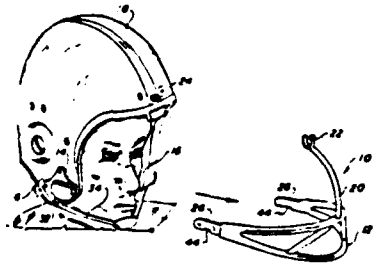
GRANTED JUNE 17, 1975

GENERAL AND MECHANICAL

3,889,296
TEAR-AWAY FACE MASK SUBASSEMBLY FOR FOOTBALL HELMETS

[illegible] M. Martin, Rt. 1, P.O. Box 37, Las Animas, Colo. 81054

Filed Feb. 13, 1974, Ser. No. 442,066
Int. Cl. A42b 1/08
U.S. Cl. 2—9 1 Claim



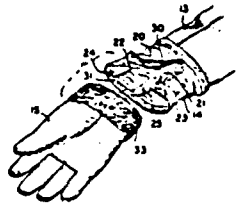
1. A tear-away face mask assembly for football helmets and the like which comprises: a pair of bracket-forming members each having a channel formed therein effective when mounted in transversely-spaced opposed relation to one another upon the exterior face of the earflaps of a football helmet to cooperate therewith and define substantially parallel forwardly-opening sockets alongside thereof; a face mask having a horizontally-arched portion with the terminal ends thereof shaped to define a pair of transversely-spaced parallel tongues positioned and adapted for simultaneous insertion into the sockets of the bracket members and a vertically-disposed upwardly and rearwardly-curved arcuate strut depending from the midpoint of said arched portion terminating at the forehead-covering portion of the helmet when attached thereto, said sockets and tongues when interengaged cooperating to produce a quick-disconnect coupling therebetween operative to permit instantaneous detachment of the mask upon application of a pulling force thereto in a direction to separate same from the helmet; and, a quick-disconnect coupling connecting said terminal strut end to said helmet, said coupling comprising a pin mountable upon the forehead-covering portion of the helmet in position to receive the terminal end of the strut and an upwardly extending generally U-shaped yoke formed on said strut end positioned to receive said pin.

3,889,297
PROTECTIVE WEARING APPAREL

Theodore Lee Jarboe, 505 Boston Ave., Takoma Park, Md. 20012, and Connie Dean Groseclose, 7105 Decatur St., Hyattsville, Md. 20784

Filed Sept. 11, 1974, Ser. No. 504,959
Int. Cl. A41d 13/08
U.S. Cl. 2—16 7 Claims

1. Protective wearing apparel comprising a two-piece combination, one of said pieces consisting of a coat, and the other of said pieces consisting of gloves for the hand, the sleeves of said coat being split longitudinally along a line extending through the cuff portion of the sleeve, the ends of said split portion, and the circumferential boundary of said cuff portion having narrow strips of Velcro material affixed t open end of said glove having affixed to the ou

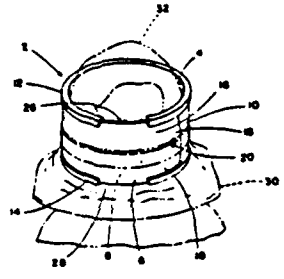


thereof a band of Velcro material completely encircling said open end.

3,889,298
HAIR BAND PROTECTOR

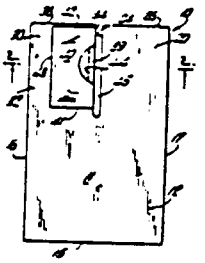
Stefania Miska, 12349 S. Bishop, Calumet Park, Ill. 60643

Filed Apr. 29, 1974, Ser. No. 465,113
Int. Cl. A42b 1/24
U.S. Cl. 2—174 4 Claims



1. A hair protector band comprising an elongated flat strip defining an upright wall of thin cross section, said wall having inner and outer wall surfaces, interlocking means located on the outside of said wall and at opposite end portions of the wall, said strip being encirclable upon itself to define a circle band position for encirclement about a head of hair of a user and said strip being extendable to an elongated length position for storage, said wall having a first upright wall surface on one side thereof and having a second upright surface on the other side thereof, said first wall surface in the circle band position being an inner wall surface for facing the hair and said second wall surface in the circle band position being an outer wall surface for embracement by a garment adapted to be sleeved thereabout, said interlocking means coupling the opposite end portions of the strip in the circle band position, said interlocking means comprising channel means on the outside upper and lower edges at one end portion of the wall and said other end portion of the wall having upper and lower edges spaced apart to fit between said channel means, said channel means of said one end portion telescopingly receiving the upper and lower edges of the other end portion with attendant overlap of said one end portion by said other end portion, said inner wall surface being smooth and said outer wall surface being rough, said smooth surface of said one end portion facing and opposing said rough surface in the band position of the strip whereby said surfaces are readily slidable along each other accommodating unimpeded circumferential adjustments of the band.

wings, said flap being transversely extendible from said one wing so as to cover at least a portion of said gap and to lie in



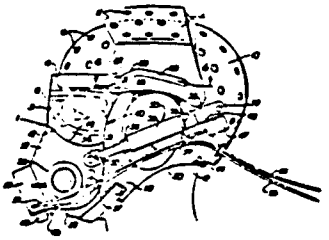
contacting relationship with at least part of the other of said pair of wings when the drape is placed on a patient.

3,910,269

INTEGRATED HELMET AND MASK STRUCTURE

William K. Ansite, Glendale, and John J. Mitchell, Jr., Arcadia, both of Calif., assignors to Sierra Engineering Co., Sierra Madre, Calif.

Division of Ser. No. 255,838, May 22, 1972, Pat. No. 3,833,935. This application Mar. 11, 1974, Ser. No. 449,777
Int. Cl.² A62B 7/00
U.S. Cl. 128—142 7 Claims



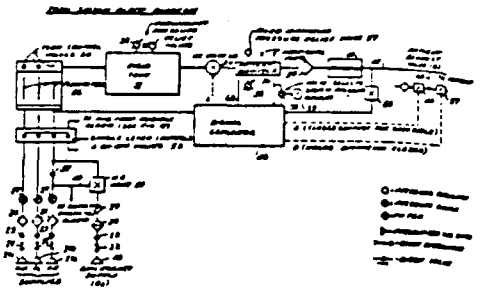
1. An integrated helmet and mask structure for the head and face of a wearer, said structure comprising a hard helmet shell, a visor assembly including a mask shell and having an articulated attachment on each side to the helmet shell and valve means on the mask shell including a supply of breathing gas for directing such gas to the mask structure, said mask shell having an inner surface adapted to face the face of the wearer, means for moving the mask shell toward and away from a position adjacent the face of a wearer, a hollow sealing tube extending around the edge of the mask shell on the side thereof facing the face, said sealing tube having a fixed sealed attachment to said mask shell, a hose in communication between the valve means and the sealing tube for introducing breathing gas from the supply for the valve means into said tube, said tube having a normally collapsed condition in a direction perpendicular with respect to the inner surface of the mask shell at all locations of attachment, said sealing tube being withdrawn from the adjacent face of the wearer when not subject to gas under pressure and an inflated condition when subject to gas under pressure, the tube when in inflated condition under pressure of gas from said gas supply being adapted to have a sealing relationship with the face of the wearer.

3,910,270

PORTABLE VOLUME CYCLE RESPIRATOR

Jeffrey Lee Stewart, New York, N.Y., assignor to Bio-Med Devices, Inc., Stamford, Conn.

Continuation of Ser. No. 287,936, Sept. 11, 1972, abandoned. This application Feb. 25, 1974, Ser. No. 445,758
Int. Cl. A61m 16/00
U.S. Cl. 128—145.8 13 Claims



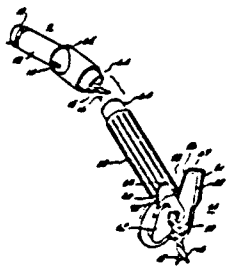
1. A portable volume cycle respirator powered by gas pressure alone, comprising means for supplying medical gas to a patient for inspiration during a first period of time, pneumatic logic means for preventing, for a preselected second period of time exhalation of gas by said patient subsequent to said first period, valve means for permitting exhalation of gas by said patient during a third period of time subsequent to said second period of time.

3,910,271

METHOD OF MAKING A BIPOLAR ELECTRODE STRUCTURE

Theodore C. Neward, 521 Scripps, Claremont, Calif. 91711

Division of Ser. No. 366,701, June 4, 1973, abandoned. This application May 24, 1974, Ser. No. 473,144
Int. Cl.² A61B 5/04
U.S. Cl. 128—2.06 E 5 Claims

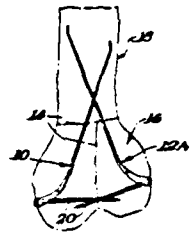


1. The combination with a fetal monitoring device, having a flexible guide tube dimensioned for insertion through the vagina and cervix of a woman in labor; electrode means disposed initially at the inner end of the guide tube for attachment and electrical contact with a fetus upon rotation thereof, a flexible drive tube slidable and rotatable in the guide tube and removably attachable to the electrode means to effect rotation thereof, and conductors extending from the electrode means through and beyond the drive and guide tubes for connection to an electrical monitoring apparatus, of a chuck and clamp means disposed at the outer ends of the guide and drive tubes, and comprising:

a. a tubular drive means secured to the flexible drive tube to receive the conductors extending therethrough;

b. a first conductor clamping element fixed to the tubular drive means, extending laterally therefrom and having

smoothly continuing the smaller end of the midportion a short distance, and a hole for a retaining screw through the end of



the head being disposed substantially at right angles to the midportion in the elevational configuration.

4,011,864

RESPIRATORY APPARATUS

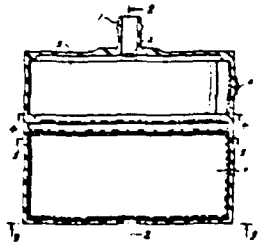
Paul Guichard, 10 Rue Gaston Darley, a Nemours 77140, France

Continuation-in-part of Ser. No. 392,341, Aug. 28, 1973, Pat. No. 3,902,486. This application Oct. 23, 1974, Ser. No. 517,429

Claims priority, application France, Aug. 29, 1972, 72.30599; Oct. 19, 1972, 72.37010; July 16, 1973, 73.25957; Oct. 24, 1973, 73.37979; Dec. 28, 1973, 73.47116

Int. Cl.² A61M 16/00

U.S. Cl. 128—140 N 9 Claims



1. In portable nasal diffuser apparatus comprising a respiratory assembly including means for communicating with the respiratory tract of a user and provided with two apertures, first and second respective valve means at said apertures operating alternately during exhalation and inhalation by the user such that when one aperture is open the other is closed, one of said apertures communicating via the respective valve means with the atmosphere, a reservoir having an inlet and containing means for treating air admitted into the reservoir, means connecting the reservoir to the respiratory assembly at the other of the apertures thereof, such that upon inhalation said valve means associated with the said other aperture is opened and air is admitted to the reservoir and flows through the treating means therein to the respiratory assembly and to the user, and means for effecting heating of the air supplied to the reservoir including means for enabling the reservoir to be positioned proximate the body of the user to capture heat therefrom, said treating means comprising a filter substance and a housing containing said filter substance and having openings for passage of air through said filter substance, said means for communicating with the respiratory tract of the user comprising a flexible nasal mask, said body including a first portion with said one aperture therein, and a second portion connected to said connecting means, said first and second valve means being supported in said body, each said valve means comprising a flat member pivotably connected in said body adjacent its respective aperture, said flat members being disposed horizontally, said one aperture being disposed in said one portion of said body below its respective flat member, said connecting means extending below the other flat member, and abutment means extending internally in said body proximate said apertures to support the respective valve members in a position of rest such that each valve member is movable in one direction only to be opened, an improvement wherein said treating means comprises an atomizer containing a volatile aromatic product, and push-button means for activating said atomizer to directly introduce vaporized aromatic product into said respiratory assembly along with respirated air.

4,011,865

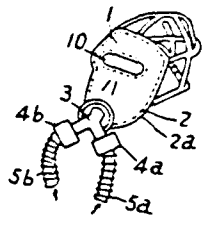
DUST-PROOF PROTECTION MASK OF FACE COVERING TYPE

Mitsu Morishita, No. 698, Takemukai, Myohoji, Sumaku, Kobe, Japan

Filed Sept. 26, 1975, Ser. No. 617,121

Int. Cl.² A62B 7/12

U.S. Cl. 128—142.3 1 Claim



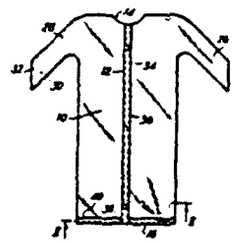
1. A dust-proof protective mask comprising a mask body adapted to fit onto a wearer's face, said mask body having an air inlet opening, a first air inlet pipe connected to said air inlet opening, an electrically driven air blower on said first air inlet pipe for feeding air under pressure to said air inlet opening, an air filter on said first air inlet pipe, a second air inlet pipe connected to said first air inlet pipe, a manually-operated air blower means mounted on said second inlet pipe and operably mounted in parallel with said electrically driven air blower, said first and second air inlet pipes each having lower ends, a three-way valve to which said lower ends of said first and second air inlet pipes are connected for selectively switching flow of atmospheric air to said first or second air inlet pipes, said mask body having a peripheral edge, clearance means on said peripheral edge for leaking out air from between said clearance means and the user's face, said mask body having a viewing opening, a transparent viewing member, means mounting said transparent viewing member in said viewing opening to provide a clearance space between said transparent viewing member and said viewing opening for allowing air on the inside of the mask to blow out through said clearance space, a colored transparent welding light shielding member mounted on the inside of said transparent viewing member, said shielding member having a height less than the height of said transparent viewing member, said shielding member having an upper edge disposed above the level of the user's eyes, said shielding member being effective to shut off harmful rays of ultra-violet, infrared rays and the like from the user's eyes, said transparent viewing member having an upper portion extending above an upper edge of said shielding member and disposed between said upper edge of said shielding member and the upper edge of said viewing opening, whereby the wearer of the mask may freely see the outside through said upper portion of said transparent viewing member.

PATENTS

GRANTED APRIL 11, 1978

GENERAL AND MECHANICAL

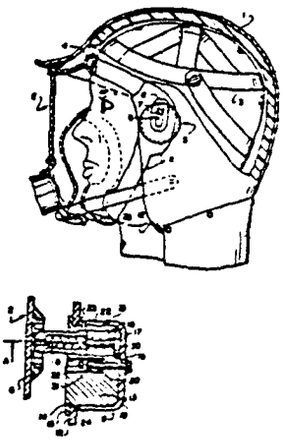
4,083,064
INFANT THERMAL SHIELD
Arnold M. Schneider, 195 Wildwood Rd., Great Neck, N.Y. 11024
Filed Mar. 28, 1975, Ser. No. 563,222
Int. Cl.[2] A41D *3/00*
U.S. Cl. 2—69.5 19 Claims



1 A thermal shield for a neonate whose thermal regulatory mechanism has not yet gained stability, comprising a garment in the form of transparent material of solid monolithic cross-sectional cross-section, the garment being of a size generally corresponding to the size of neonates whose thermal regulatory mechanism has not yet gained stability, but permitting the insertion of implements between the material and the neonate's body, the material being sufficiently pliable so as to conform generally to the neonate's body when draped over the neonate's body and so as to be capable of being manually held in close tight contact with portions of the neonate corresponding to at least the area of the head of a stethoscope but not so pliable as to be capable of molding to the configuration of the neonate's face and thereby suffocating the neonate, the garment having a sealable vertical open edge for facilitating placing the garment on the neonate, means for sealing the vertical open edge and a neck opening constituting one extremity of the garment whereby the garment is hoodless.

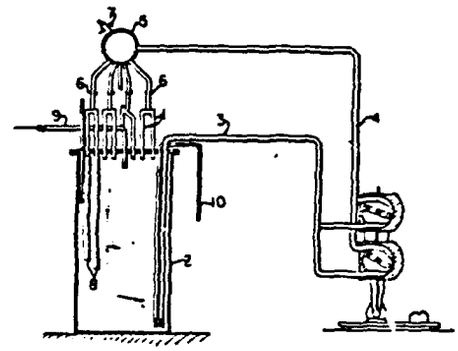
4,083,065
PROTECTIVE HELMET AND FULL FACE MASK CONSTRUCTION
Ernst Warucke, Lubeck, Germany, assignor to Dragerwerk Aktiengesellschaft, Germany
Filed Nov. 8, 1976, Ser. No. 740,133
Claims priority, application Germany, Nov. 7, 1975, 2549979
Int. Cl.[2] A42B *1/08*
U.S. Cl. 2—424 6 Claims

1 A protective helmet and full face mask for combined use on the face and head of a wearer, comprising a mask adapted to fit over the face and having a peripheral portion for encircling the chin, jaw and forehead of the face, a helmet adapted to engage over the head and having at least one portion adapted to overlie a portion of said mask, said mask having a receiving bearing recess in the overlying portion, said helmet having a locking mechanism comprising a member rotatably mounted on said helmet having a cavity extending toward said mask eccentric to the axis of said member, a pin of substantially the same width as the bearing recess and being movable in said cavity between a locking position in which it projects out of said cavity for engagement into said bearing recess and an unlocked position withdrawn into said cavity, said member being rotatable with said pin engaged in said recess to move said mask toward said helmet for tighter engagement with the wearer's face, a cam follower carried by said pin, and cam



means engageable with said cam follower for moving said pin in said cavity.

4,083,066
HETEROLOGOUS ARTERIAL TRANSPLANTS
Heribert Schmitz, Trogen, and Walter Stocklin, Ettingen, both of Switzerland, assignors to Solco Basel AG, Basel, Switzerland
Filed Nov. 7, 1975, Ser. No. 629,752
Claims priority, application Germany, Nov. 11, 1974, 2453363
Int. Cl.[2] A61F *1/24*; A63B *51/02*
U.S. Cl. 3—1.4 6 Claims



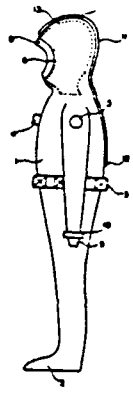
1. A process for the preparation of heterologous arterial transplants comprising freeing animal arteries of surrounding tissue, ligating collateral branches, subjecting the resulting arteries to proteolysis to remove elastic fiber and muscle tissue to obtain collagen tubes and tanning said tubes to effect cross-linking, the said proteolysis and tanning steps being effected by proteolytic and tanning solutions which continuously flow in one direction both through said arteries and along the outer surface of said arteries.

PATENTS

GRANTED JANUARY 30, 1979

GENERAL AND MECHANICAL

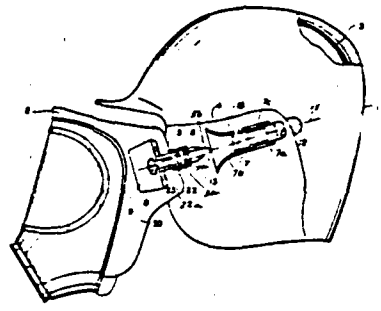
4,136,402
SUIT WITH INNER HOOD
[illegible] E. Iaulan, Brasted, and Jorn Stubdal, Fagerstrand, both of Norway, assignors to Viking-Askim A/S, Askim, Norway
Filed Sep. 8, 1977, Ser. No. 831,557
Claims priority, application Norway, Sep. 9, 1976, 763090
Int. Cl.[2] B63C *11/04*
U.S. Cl. 2—2.1 R 14 Claims



1. A unitary dry protective water and air impervious suit adapted to cover the entire body of a wearer except the hands and the face, comprising
a body part having an upper portion sealingly surrounding the neck of a wearer and covering the body below the neck;
said body part being inflatable to provide heat insulation between the body part of the suit and the body of the wearer;
a hood having an opening for the wearer's face and being sealingly connected to said upper portion;
said hood including in overlapping relationship a water and air impervious outer layer, and
an inner layer,
said layers being sealed to one another at said face opening to define with one another an inflatable clearance surrounding the head of the wearer; and
means for communicating with the interior of said body part to provide heat insulation in form of a thermally insulating layer which surrounds the entire body of the wearer except for the face and hands, said suit further comprising a gas and water-proof zipper extending along a vertical centerline of said suit from the vicinity of said face openings rearwardly over said hoods and down the back of the suit.

4,136,403
HEAD GUARD ASSEMBLY COMPRISING A PROTECTIVE HELMET AND A PROTECTIVE BREATHING MASK
[illegible] J. Walther, and Manfred Gdulla, both of Lübeck, Germany, assignors to Dragerwerk Aktiengesellschaft, Germany
Filed Sep. 7, 1977, Ser. No. 831,133
Claims priority, application Fed. Rep. of Germany, Sep. 10, 1976, 2640701
Int. Cl.[2] A42B *3/00*
U.S. Cl. 2—10 6 Claims

1. A head guard assembly, comprising a protective head [illegible], a face protective breathing mask, and coupling means [illegible] on each respective side of said helmet and said mask for releasably interengaging said helmet and said mask and including a socket-forming member on one of said helmet and mask and a coupling pin on the other of said helmet and mask, said socket-forming member having an oval outwardly tapered receiving socket bore with an internal widened portion defining a catch groove therein, said coupling pin having a necked-down portion, at least one engagement member in said necked-down portion movable radially outwardly into engagement with said catch groove, a sleeve slidable along said coupling pin to engage over said engagement member and retain it in said necked-down portion, biasing means between said sleeve and said coupling pin to urge said sleeve over said engagement member, said coupling member including a head portion of a diameter greater than said necked-down portion displaceable



toward said engagement member when said coupling pin is positioned within said socket-forming member and said sleeve being displaceable against the bias of said biasing means and away from said engagement member when said coupling pin is engaged within said socket forming member so that said head portion of said coupling pin urges said engagement member radially outwardly into engagement with said catch groove through the action of said biasing means whereby said coupling pin may be displaced against the bias of said biasing means to position said necked-down portion adjacent said engagement member to permit the radially inwardly displacement of said engagement member out of engagement with said catch groove and the withdrawal of said coupling pin from said socket-forming member.

4,136,404
ATHLETIC LEG BRACE APPARATUS
Robert B. Lange, 3732 Wonderland Hill Ave., Boulder, Colo. 80302
Filed Mar. 14, 1977, Ser. No. 777,510
Int. Cl.[2] A41D *13/00*
U.S. Cl. 2—22 13 Claims

1. An athletic leg brace apparatus of the type operable to be connected to the sides of a ski boot comprising:
first lower leg brace means for extending generally vertically along one lateral side of a skiers lower leg;
second lower leg brace means for extending generally vertically along the other lateral side of a skiers lower leg;
first upper leg brace means for extending generally vertically along one lateral side of a skiers upper leg;
second upper leg brace means for extending generally vertically along the other lateral side of a skier's upper leg;
first hinge means connected between an upper portion of said first lower leg brace means and a lower portion of said first upper leg brace means for permitting unencumbered forward and backward flexing of a skier's knee while substantially transmitting lateral forces through said first hinge means;

PATENTS

GRANTED APRIL 24, 1979

GENERAL AND MECHANICAL

4,150,442

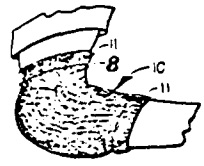
ELBOW OR HEEL PROTECTOR

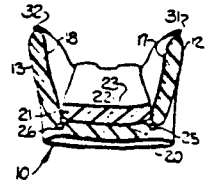
[illegible] S. Boone, Valdese, N.C., assignor to Alba-Waldensian, Incorporated, Valdese, N.C.

Filed Jun. 12, 1978, Ser. No. 914,415

Int. Cl.[2] A41D *13/08*; A61B *19/00*

[illegible] 2—16 7 Claims





1 An elbow or heel protector for providing cushioning to [illegible] bed patients and the like, said protector comprising

(a) a tubular sleeve stretchable in both longitudinal and circumferential directions and being adapted to provide a snug fit over the arm or foot of the patient,

(b) pad means positioned within said sleeve to receive and cushion the patient's elbow or heel, said pad means being of substantially U shaped transverse cross-sectional configuration in the central portion thereof and including

(1) opposite side panels of resilient foam material defining opposite sides of said U-shaped cross-sectional configuration, each of said side panels including an upper peripheral edge and a pair of converging lower edges extending from said upper peripheral edge,

(2) a pair of superpositioned substantially rectangular bottom panels of resilient foam material including opposite sides and opposite ends and defining the bottom of said U-shaped cross-sectional configuration,

(3) first seam means connecting together corresponding opposite ends of said superpositioned substantially rectangular bottom panels of resilient foam material, and

(4) second seam means connecting said lower edges of said opposite side panels to the corresponding opposite sides of the lowermost of said superpositioned substantially rectangular bottom panels of resilient foam material, the opposite sides of the uppermost of said substantially rectangular bottom panels of resilient foam material being free of connection to said side panels and covering said second seam means to prevent contact of the patient with said second seam means, and

(c) means securing said pad means in position within said sleeve.

4,150,443

ANTI-FOGGING SPORTS GOGGLE

Michael A. McNeilly, South of Ketchum, Id., assignor to Robert E. Smith, Ketchum, Id.

Filed Mar. 13, 1978, Ser. No. 885,965

Int. Cl.[2] A61F *9/02*

U.S. Cl. 2—436 13 Claims

1. An anti-fogging sports goggle comprising a lens structure sufficiently wide to span the eyes of the wearer, closure means in conjunction with said lens structure to position said lens structure a sufficient distance from the eyes of the wearer to permit the wearer to wear eyeglasses beneath the goggle in the air space between the lens structure and the face of the wearer, strap means to removably maintain the goggle in position on the wearer's head, and a motor and fan unit carried directly on and forming part of the goggle without projection exteriorly therefrom to forcibly circulate the moist warm air present in said air space over the glasses of the wearer and over the inner surface of said lens structure to preclude condensation build-up on said glasses and on said inner surface of said lens structure; said motor and fan unit being integral with said goggle and mounted directly thereon to preclude the entry of ambient air directly therethrough into said air space.

4,150,444

PROSTHETIC JOINT

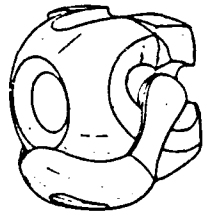
Carl-Göran A. Hagert, Barnhemsgatan 37, 43131 Mölndal, Sweden

Filed Jun. 27, 1977, Ser. No. 810,210

Claims priority, application Sweden, Jun. 28, 1976, 7607345

Int. Cl.[2] A61F *1/24*

U.S. Cl. 3—1.91 18 Claims



1. A prosthetic joint comprising a first and a second joint member angularly movable with respect to each other, each of said members being arranged to be attached to one of a pair of skeletal bones, in which said first joint member is a joint head having a base face for resting on a supporting surface provided on one of the skeletal bones, a convex slide face shaped as a part of a surface of revolution having an axis extending through the joint head at a distance from said flat face, and a

PATENTS

GRANTED MAY 29, 1979

GENERAL AND MECHANICAL

4,156,292
DISPLAY CARRYING AND PPOTECTIVE HELMET

David P. Helm, Burke, and William S. Flogaus, Alexandria, both of Va., assignors to The United States of America as represented by the Secretary of the Army, Washington, D.C.

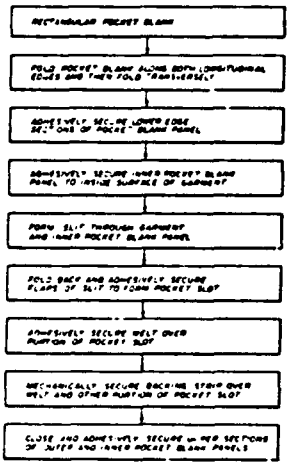
Filed May 23, 1978, Ser. No. 908,872
Int. Cl.[2] A42B 3/02; F41H 1/04
U.S. Cl. 2—6 7 Claims

1. A helmet system for carrying helmet mounted display means having a support end and an ocular end, said system including: a form-fit helmet liner having a face mask integral therewith, wherein said mask has a connector for said ocular end of said display means; and a helmet outer shell having an engagable mount for said support end of said display means.

4,156,293
POCKET CONSTRUCTION

Joseph W. A. Off, Irving, Tex., assignor to Haggar Company, Dallas, Tex.

Continuation of Ser. No. 819,843, Jul. 28, 1977, abandoned. This application May 11, 1978, Ser. No. 905,054
Int. Cl.[2] A41D 27/20
U.S. Cl. 2—247 47 Claims



1. In a method of constructing pockets in garment panels wherein a length of pocket material having reverse and obverse sides is connected to the garment panel, folded transversely to form inner and outer pocket panels, and secured at adjacent edges and ends of the folded length of pocket material, the improvement comprising the steps of:

positioning the reverse side of the length of pocket material on the inside surface of the garment panel wherein a pocket is to be formed;

adhesively securing the length of pocket material to said garment panel;

forming a slit through the adhesively secured area between the garment panel and the length of pocket material;

folding the secured edges of the garment panel and the pocket material surrounding the slit inward against the obverse side of the length of pocket material, and

securing the inwardly folded edges of the garment panel and the pocket material to the obverse side of said pocket material to form a pocket slot.

4,156,294
BASEBALL UNDERGARMENT

Spencer C. Horn, 301 E. 7th St., Cushing, Okla. 74023

Filed Jun. 27, 1977, Ser. No. 810,172
Int. Cl.[2] A41B 9/00
U.S. Cl. 2—400 7 Claims

5. A baseball undergarment comprising:

knee length underpants of generally form fitting material and having at least a waist portion and right and left legs,

first and second full foot undersocks of knee length;

first and second ankle socks of knee length each disposed to enclose a respective first and second undersock; and

means stitching said first undersock and ankle sock and said second undersock and ankle sock to a respective right and left legs.

4,156,295
REVISED POCKET

Edward W. LeRoy, 45-25 Kennedy Blvd., North Bergen, N.J. 07047

Continuation-in-part of Ser. No. 551,162, Feb. 19, 1975, abandoned. This application Mar. 3, 1976, Ser. No. 663,559
Int. Cl.[2] A41D 27/20
U.S. Cl. 2—252 3 Claims

1. A revised pocket, comprising:

a fabric of a garment,

a backing panel attached to a rear surface of the fabric,

a front panel attached to the fabric overlying the backing fabric,

a lower attaching strip of a lower section of a zipper attached to an inner surface of an upper end of the front panel of the revised pocket,

an upper attaching strip attached to an upper portion of the zipper and attached to the garment fabric and the reinforcing rear panel,

a flap attached to the fabric and upper attaching strip of the upper part of the zipper,

the front panel and the reinforcing rear panel each form a lower elongated section of rectangular shape having a flat

: for establish-
... and said inlet
chamber;

(d) means defining a valve outlet in said housing; said valve outlet being in continuous communication with said inlet chamber and being connected to the inlet of said three-way non-rebreathing valve;

(e) valve seat arranged on said housing and surrounding said valve inlet;

(f) a movable valve member supported in said housing adjacent said valve inlet for opening and closing said valve inlet, said movable valve member having

(1) a valve stem supported in said housing in the zone of said valve inlet for longitudinal displacement through said housing in a closing direction and in an opening direction;

(2) a soft, readily deformable resilient valve flap attached to one end of said valve stem and cooperating with said valve seat, said valve flap having an open position in which it is spaced from said valve seat for maintaining communication between said bladder and said inlet chamber; said valve flap having a contacting position in which it contacts said valve seat in an undeformed state; said valve flap having a closed position in which it engages said valve seat in a deformed state; in said closed position gas flow from said bladder to said inlet chamber is fully blocked; and

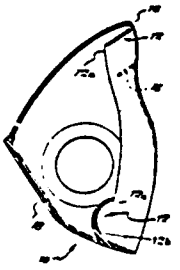
(g) control means responsive to pressure in said inlet chamber connected to said valve stem at a location spaced from said one end thereof for moving said valve stem in said closing direction and maintaining said valve flap in said closed position when the pressure in said inlet chamber exceeds predetermined values above the ambient pressure and for moving said valve stem in said opening direction and maintaining said valve flap in said open position when the pressure in said inlet chamber is below said predetermined values; the pressure in said inlet chamber needed for moving said valve stem into a position in which said valve flap assumes said closed position being only by a small increment larger than the pressure in said inlet chamber needed for moving said valve stem into a position in which said valve flap assumes said contacting position.

4,167,185

FACE MASK SEAL

Robert D. Lewis, Coloma, Mich., assignor to A-T-O Inc., Willoughby, Ohio

Filed Apr. 18, 1977, Ser. No. 788,237
Int. Cl.² A62B 7/00
U.S. Cl. 128—146.7 8 Claims



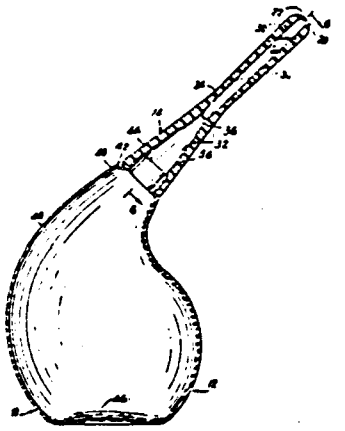
1. A face seal comprising, in combination with a mask body having an open side adapted to fit about a facial portion of a user, said body defining a facial portion receiving cavity defining an inner body surface and having a marginal edge portion around said open side thereof, sealing means adapted to form a seal between said body and the face of a user thereof, said sealing means comprising a resiliently flexible perimetrical sealing element in the form of a re-entrant flap joined to said body adjacent to said marginal edge portion and normally folded inwardly over said inner surface of said mask body, ... spaced therefrom whereby said face seal is conformable ... sealing relation to a facial portion of a user independently ... said body, and resilient strut-like web means extending ... tween said sealing element and said inner surface of said ... at selected locations spaced apart about the perimeter of ... open side of said body and corresponding to the deepest ... of the facial portion of a user, said web means being oper... to mechanically urge said sealing element against such ... areas of the facial portion of a user.

4,167,186

SYRINGE, SUCH AS A VAGINAL DOUCHE, AND CANNULA THEREOF

Ernest W. Pick, Cos Cob; Joseph M. Denaro, Stamford, ... Henry R. Goerke, Norwalk, all of Conn., assignors to The Purdue Frederick Company, New York, N.Y.

Filed Sep. 8, 1977, Ser. No. 831,595
Int. Cl.² A61M 1/00
U.S. Cl. 128—232 5 Claims



1. A syringe, such as a vaginal douche, comprising a ... consisting of an elongated hollow tubular body having a ... tral axis and having one open end and distant therefrom ... opposed transverse end wall formed with an opening ... therethrough and through which said central axis extends, ... cannula body having substantially midway between said ... end and transverse end wall thereof a minimum transverse ... cross section in a plane perpendicular to said axis and said ... tapering slightly from said transverse end wall toward ... minimum cross section while tapering to a substantially ... extent from said open end toward said minimum cross ... the latter portion of said body between said open end ... minimum cross section thereof forming part of a hollow ... and said body being formed at its exterior between said ... mum cross section and transverse wall with a plurality of ... grooves distributed uniformly about said axis with said ... having ribs situated between said grooves and said body ... formed inwardly of said ribs between said minimum ... section and transverse wall thereof with a plurality of ... through which a liquid in the hollow interior of said body ... discharge with the liquid also being capable of discharging ... through said central opening of said end wall of said body, ... a squeeze bottle removably connected with said cannula ... at said open end thereof, said squeeze bottle having next to ... cannula body an open end region which tapers in the same ... as said body at the region of said open end thereof and forms ... an extension of said open end of said body, said squeeze ... having distant from said open end region thereof a flat end ...

PATENTS

GRANTED OCTOBER 23, 1979

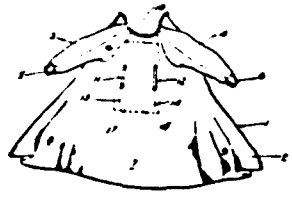
GENERAL AND MECHANICAL

4,171,542

SPOSABLE SURGICAL GOWN WITH A BIB FORMING A HAND SUPPORT

A. Cox, Memphis; Doyle R. Johnson, Arlington; Donald f. Maskey, and William A. Mueller, both of Memphis, all of ...., assignors to Buckeye Cellulose Corporation, Memphis, ...

Filed Jun. 5, 1978, Ser. No. 912,333
Int. Cl.² A41D 13/00
S Cl. 2—51 14 Claims



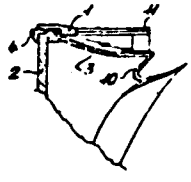
1 In a surgical gown of the type having sleeves, a front ... having a chest area covering the chest of the user and ... portions which close and overlap at the back of the user, ... improvement comprising a bib affixed about its periphery ... the inside surface of said surgical gown at said chest area ...eof with a portion of said bib inwardly of said periphery ...aining unsecured to said gown, said chest area of said gown ...ing a pair of spaced, substantially vertical slits formed ...een within the confines of said peripheral portions of said ... said slits communicating with said unsecured portion of ... bib and being of such length as to permit passage of the ...'s hands therethrough whereby said bib provides a sterile ... support pocket maintaining the user's hands in the aseptic ... bounded by the user's neck, shoulders and waist line.

4,171,543

MASK FOR SKIN-DIVING

Leopoldo A. Cressi, Genova-Quinto, Italy, assignor to Cressi-Sub S.p.A., Genova-Quinto, Italy

Filed Dec. 23, 1977, Ser. No. 864,040
Claims priority, application Italy, Mar. 23, 1977, 12523 A/77
Int. Cl.² A61F 9/02
U.S. Cl. 2—428 6 Claims



1 An improved diving mask comprising:
a generally tubular rubber body including a forward end portion having an integrally-formed nose-embracing portion and a rearward end portion configured to embrace the user's face;
a viewing lens;
a mounting frame surrounding and secured to the rim of said lens, said frame having an outer peripheral surface, the forward portion of which has a generally annular-shaped channel formed therein and the rearward portion of which is rearwardly and inwardly conically-tapered, and
a generally tubular fairing body configured to surround and embrace a substantial portion of said rubber body, said fairing body having a generally annular-shaped projection extending inwardly from its inner peripheral surface, adjacent to the forward edge thereof, configured and dimensioned for snap-fit engagement with said channel of said frame, said inner peripheral surface of said fairing body also having an inwardly offset step formed rearwardly of said projection providing a seat on which the forward edge of the rubber body may rest, said step being disposed to cooperate with said conically tapered rearward portion of said frame upon snap-fit engagement of said projection of said fairing body with said channel of said frame, so as to sealingly secure said forward edge of said rubber body therebetween.

4,171,544

BONDING OF BONE TO MATERIALS PRESENTING A HIGH SPECIFIC AREA, POROUS, SILICA-RICH SURFACE

Larry L. Hench, Gainesville, Fla., and Michael M. Walker, Troy, N.Y., assignors to Board of Regents, for and on behalf of the University of Florida, Tallahassee, Fla.

Filed Apr. 5, 1978, Ser. No. 893,792
Int. Cl.² A61F 1/24; A61B 17/18; C03C 3/04, 3/22
U.S. Cl. 3—1.9 13 Claims

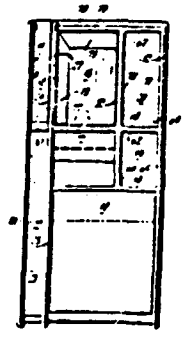
1. A dental or surgical implant having a surface for bonding to the bone of a recipient, said bonding surface comprising a biologically compatible glass, glass-ceramic or ceramic material comprising at least about 80 weight percent silicon dioxide and having a specific surface area of at least about 80 square meters per gram, a porosity of from about 10 to about 50 volume percent, and an average pore diameter of from about 20 to about 300 Angstroms.

4,171,545

MODULAR LAVATORY CONSTRUCTION

Henry R. Kann, New York, N.Y., assignor to The Charles Parker Company, Meriden, Conn.

Filed Jul. 19, 1974, Ser. No. 489,540
Int. Cl.² A47K 1/00, 1/04, E03C 1/32
U.S. Cl. ... 1 16 Claims

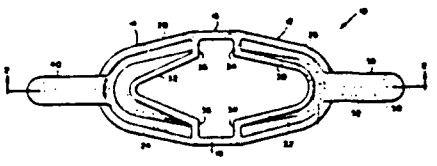


1 A unitary modular lavatory-wall unit for wall-hung mounting in side-by-side adjacent multiple, and having a generally rectangular front elevation between upstanding horizontally spaced side walls which extend forwardly of a wall-mounting plane, said side walls having elongate upstanding forward edges defining a front-access plane parallel to and offset from the wall-mounting plane, comprising a single-piece integral molded plastic structural combination wherein said

4,173,218
GLOVED SPLINT FOR AN ARTHRITIC HAND
Penny S. Cronin, 7831 W. Zucca Dr., Peoria, Ariz. 85345
Filed Nov. 23, 1977, Ser. No. 854,130
Int. Cl.² A61F 5/10
U.S. Cl. 128—77 11 Claims

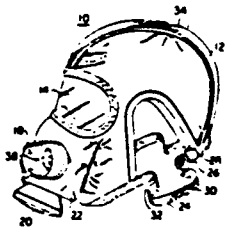
1. A hand protector for supporting and protecting the fingers of an arthritis stricken hand, said hand protector . . . comprising in combination:
(a) a palm splint positionable in juxtaposed relationship to the palm of the hand, said palm splint being configured to permit unrestricted normal movement of the thumb;
(b) a finger splint extending from said palm splint for supporting each respective finger but not thumb in a non-laterally moveable relationship to the palm;
(c) means for flexing a section of at least one of said finger splints to permit flexing of the fingers along a single axis only to control opening and closing of the fingers of the hand, said flexing means being positionally commensurate with a joint of the respective finger; and
(d) glove means for maintaining said palm splint and said finger splints in juxtaposed relationship with the respective parts of the hand while enclosing at least the fingers and palm of the hand, said glove means including:
i. shock absorbing means for buffering impacts and blows to the hand; and
ii. means for opening and closing said glove means to facilitate insertion and withdrawal of the hand therefrom, whereby, said finger splints preclude lateral skewing of the fingers due to involuntary muscle contractions and yet permit mobility of the thumb and mobility of the fingers to flex.

4,173,219
DISPOSABLE DENTAL TRAY
Frank N. Lentine, Taylor, Mich., assignor to Sybron Corporation, Rochester, N.Y.
Filed Jan. 30, 1978, Ser. No. 873,269
Int. Cl.² A61M 35/00
U.S. Cl. 128—260 5 Claims



1. A dental tray for applying medicaments and the like to teeth comprising:
(a) an upper tray portion for the upper dentition and a lower tray portion for the lower dentition;
(b) each of said tray portions including an outer shell of closed cell polyethylene foam, said outer shell having a generally U-shaped base approximating the curve of the dental arch and integrally formed buccal, lingual and re walls upstanding from said base so as to form a close medicament holding trough;
(c) said base being flat in cross section from the poster ends of said U-shape to the bicuspid region and conca from the bicuspid region to the anterior end;
(d) said buccal wall being generally normal to said base fro the anterior to the posterior ends;
(e) said lingual wall being generally normal to said base a the posterior ends and inclined with respect to said base a direction away form said buccal wall at the anterior enc the angle of inclination of said upper tray lingual wa being greater than the angle of inclination of said lowe tray lingual wall;
(f) said buccal and lingual walls being lower at the poster than at the anterior ends so as to form a trough whic increases in depth from the posterior to anterior ends;
(g) hinge members extending between and connected to the posterior ends of said tray portions connecting said tra portions together;
(h) a layer of open cell polyurethane hydrophillic foa bonded to and lining the entire inner surface of said tra portions;
(i) a handle extending outwardly from the upper edge o each buccal wall at the anterior end thereof.

4,173,220
FACEMASK
Thomas J. Ratz, Greenbelt, and Ralph L. Baker, Baltimore, bo of Md., assignors to Midori Anzen Company, Ltd., Tokyo Japan
Filed Jul. 5, 1977, Ser. No. 812,629
Claims priority, application Japan, Jul. 5, 1976, 51-88225
Int. Cl.² A62B 7/00
U.S. Cl. 128—142.7 2 Claim



1. A facemask for use in a closed circuit breathing syste comprising:
a soft, flexible hood for closely covering the head of a use and having a cut-away portion at opposite side portion corresponding to the user's ears for exposing the user ears when the facemask is worn;
a transparent flexible eye piece secured to said hood fo allowing the user to see therethrough, said eye piece bein substantially flush with the hood for forming a continu ous, low profile contour with said hood;
a breathing mask secured to said hood and including mean adapted to hermetically envelope the mouth and the na trils of the user when the facemask is worn by the user fo forming a closed breathing chamber between said breath ing mask and the facial skin of the user, said breathing mask having means for connecting breathing hoses to sa breathing mask for directly flow of breathing gas directl into and out of said breathing mask, a voice disc on sai breathing mask for allowing voice communications by th user, and check valve means in said means for connectin breathing hoses for regulating the direction of flow of th inhalation and exhalation gases to and from said breathing chamber; and

supporting means constituting part of said hood for firmly supporting said breathing mask on the oro-nasal portion of the user's face and constituted by inelastic straps integrally attached to said hood and extending across the top and down the back of said hood, and inelastic adjusting bands connected across said cut-away portion of said hood adjacent the lower edges of said hood and means for adjusting said bands to adjustably secure the hood to the head of a user

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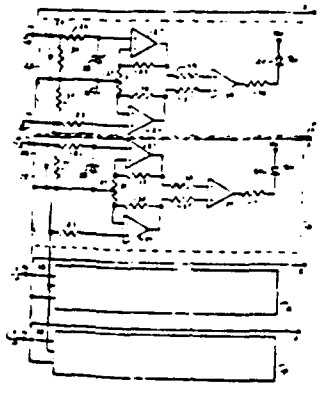
4,173,221

EKG CABLE MONITORING SYSTEM

Richard J. McLaughlin, Hawthorne, Calif., and Wallace J. Rogozinski, 26 Dragonfly, Irvine, Calif. 92714, assignors to Wallace Rogozinski, Irvine, Calif.

Continuation-in-part of Ser. No. 787,976, Apr. 15, 1977, abandoned. This application Jun. 30, 1978, Ser. No. 920,740
Int. Cl.[2] A61N 1/36
U.S. Cl. 128—696 8 Claims



1 An EKG cable monitoring system for use with a cable assembly having a plurality of test leads connected to a cable connector for a multiconductor cable to an EKG unit and including at least one reference lead and a plurality of signal leads connected to electrodes electrically coupled to the skin of a patient, said system comprising:

a visual display including a plurality of display devices, each electrically coupled to an associated signal lead and mounted on said cable connector in positional association with the signal lead to which it is coupled, and

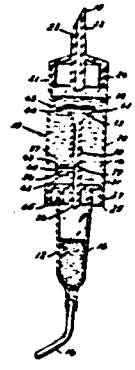
separate display drive means coupled across each signal lead and a reference lead, each drive means comprising a pair of primary differential amplifiers, the combined outputs of which are connected to drive a single one of said display devices, wherein a single one of each of said signal leads is coupled to a single one of said drive means, and therein coupled to a first polarity iput of a first one of said pair of primary differential amplifiers and said reference lead is connected to the first polarity input of the second one of said pair of primary differential amplifiers, and the opposite polarity inputs to said differential amplifiers are connected to a common floating ground.

4,173,222

APPARATUS FOR CONTROLLABLY ADMINISTERING A PARENTERAL FLUID

Andrew J. Muetterties, Gages Lake, Ill., assignor to Abbott Laboratories, North Chicago, Ill.

Filed Aug. 19, 1976, Ser. No. 715,810
Int. Cl.[2] A61M 5/16
U.S. Cl. 128—214 C 31 Claims



1. An apparatus for administering a parenteral liquid from a parenteral liquid container to the patient comprising:

a reservoir chamber;

connection means for said fluid container in fluid-tight engagement with one end of said chamber, said connection means defining a fluid flow inlet passageway into said chamber;

means defining a closure for another end of said chamber, said closure means providing for a fluid flow outlet passageway;

fluid passage means extending into said chamber and in communication with said fluid flow inlet and outlet passageways;

means disposed in said chamber defining a first and a second orifice in communication with said fluid flow outlet passageway with at least one of said orifices communicating with said fluid passage means, said first and second orifices spaced from each other a predetermined distance and separately communicating with said outlet passageway;

means operatively associated with said first and second orifices and within said reservoir chamber to provide a reservoir of said liquid for flow through said second orifice after flow of said liquid through said first orifice and to substantially eliminate the flow of air into said first orifice; and

means operatively associated with said outlet passageway for administering said liquid.

4,173,223

CHAMBER ASSEMBLY FOR INFUSION AND TRANSFUSION APPARATUS

Kenneth C. Raines, and Robert J. LeFevre, both of Bethlehem, Pa., assignors to National Patent Development Corporation, New York, N.Y.

Filed Oct. 17, 1977, Ser. No. 843,064
Int. Cl.[2] A61M 5/16
U.S. Cl. 128—214 C 11 Claims

1 A connecting apparatus for use with infusion and transfusion systems comprising:

a piercing device assembly for connection to a source of fluid;

a tubing adaptor for connection to a length of tubing; and

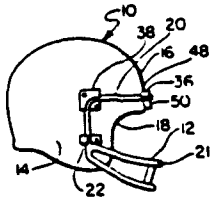
a drip chamber assembly connecting said piercing device assembly to said tubing adaptor, said drip chamber including an observation chamber having port means located at

PATENTS

GRANTED NOVEMBER 18, 1980

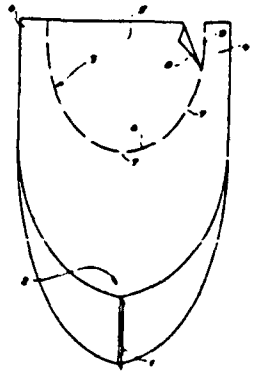
GENERAL AND MECHANICAL

4,233,687
SPORTS HELMET WITH FACE MASK
William E. Lancellotti, 371 Broadway, Providence, R.I. 02909
Filed Aug. 14, 1978, Ser. No. 933,783
Int. Cl.[3] A63B 71/10; A42B 3/00
U.S. Cl. 2—9 1 Claim



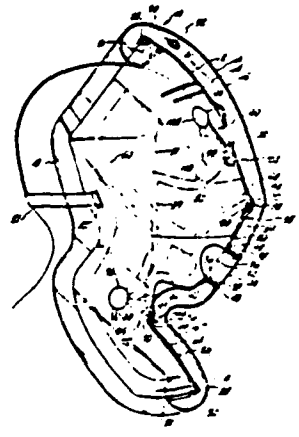
1 A safety device for use with a protective sports helmet in the having downwardly extending opposed side portions and an upper central connecting portion forming a centrally disposed facial opening, comprising a mask adapted for disposition over said facial opening to protect the face of the wearer, said mask including a peripheral rod-like frame which has portions extending vertically along the outer surfaces of said side portions and then forwardly across the top front of said helmet whereby said frame extends generally around said facial opening, attachment means mounted on the outer surfaces of said side portions, said means comprising a pair of vertically spaced blocks on each side portion, said blocks each having grooves therein with reduced lead-in portions adapted to detachably snap-receive said frame, the bottom block on each side being adapted to receive said vertically extending portion adjacent the lower end thereof and the top block on each side having a curved groove configured to receive the corners where said vertical portions merge with said forward portion, said grooves all being at least partially exposed in a forward direction whereby said mask may be readily detached from said helmet in a forward direction by a pull thereon comprising a significant forward force component.

4,233,688
BIB
Jonna Hjerl, Freltoftevej 22, DK-5653 Near Lyndelse, Denmark
Filed Jan. 9, 1979, Ser. No. 2,057
Int. Cl.[3] A41B 13/10
U.S. Cl. 2—49 R 1 Claim



1 A bib formed from a substantially rectangular soft sheet material and having a pocket at one end and wherein at the other end of the sheet a single rupture line defines a narrow tie-strip at each side edge of the sheet and further defines a neck-line cutout, the sheet material inside said neckline cutout forming a napkin bounded by the end edge of the sheet and totally removable from the bib along said rupture line.

4,233,689
PROTECTIVE HEADGEAR
Stephen H. Baron, 3967 Eureka Dr., Studio City, Calif. 91604
Filed Mar. 27, 1978, Ser. No. 890,242
Int. Cl.[2] A42B 3/00; A63B 69/02
U.S. Cl. 2—413 10 Claims



1. Protective headgear for protecting the wearer's head and face, said headgear comprising a transparent inner shell adapted to fit over the wearer's face, an outer sheet of transparent material extending over said inner shell and about the perimeter portion thereof and being sealably secured to said inner shell along the perimeter portion thereof defining an air tight chamber about said inner shell, a portion of said chamber extending about and inwardly of the perimeter portion of said inner shell, valve means for inflating said chamber to render said chamber shock absorbing, and means for securing said inner shell and outer sheet on the wearer's head.

4,233,690
PROSTHETIC DEVICE COUPLINGS
Robert J. Akins, La Mesa, Calif., assignor to CarboMedics, Inc., San Diego, Calif.
Filed May 19, 1978, Ser. No. 907,664
Int. Cl.[3] A61F 1/22
U.S. Cl. 3—1.5 3 Claims

1. A prosthetic heart valve for long term implantation in the human body including

a generally tubular rigid portion,

a circumscribing sewing ring disposed in encircling relationship to said rigid tubular portion, and

a coupling element embedded within said sewing ring for joining said sewing ring to said heart valve tubular portion wherein the improvement comprises

said coupling element being made of a nickel-titanium alloy having a transition-temperature range, said element having been formed to a precise shape at a temperature above said range and having been deformed to a different shape at a temperature below said range whereby joinder of said

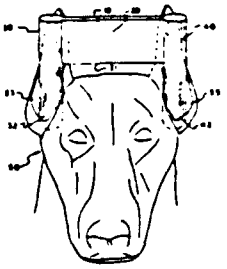
fulcrum by the wearer while the neck tractioning device is applying tensile force to the neck of the wearer, said attaching means including a pair of collars slideably mounted on said framework such that said collars are adjustable in a direction substantially parallel to the direction of separation between the shoulder mount and head assembly and securing means associated with said collars for releasably securing said collars in fixed relation to said framework and a rigid U-shaped bar having its opposite ends each secured to a respective one of said collars and adapted for surrounding the rear of the neck in spaced apart relation thereto, said neck engaging means being mounted on said bar such that when said apparatus is worn said neck engaging means is positioned between said bar and the rear surface of the neck.

4,250,875

CANINE EAR STRENGTHENING AND TRAINING DEVICE

Thomas E. Marsh, and Pamela S. Marsh, both of R.R. 1, Box 251, Parker City, Ind. 47368

Filed Feb. 2, 1979, Ser. No. 9,230
Int. Cl.³ A61F 13/00; A01K 29/00
U.S. Cl. 128—82 1 Claim



1 A canine ear strengthening and training device to be secured upon the head of a dog which comprises:

two columnar shafts each having an upper and a lower end, the lower end of said shafts being shaped for insertion into the ear canals of a dog, said shafts having the form of right circular cylinders, and said lower ends of said shafts being hemispherical in shape so as to prevent injury to the inner ear; and

a transverse member affixed to the upper ends of said shafts, and extending between them perpendicular to their axes, of a length corresponding to the distance between the ears of the dog upon which the device will be used, so that said columnar shafts, when inserted into the dog's ear canal, are spaced symmetrically apart.

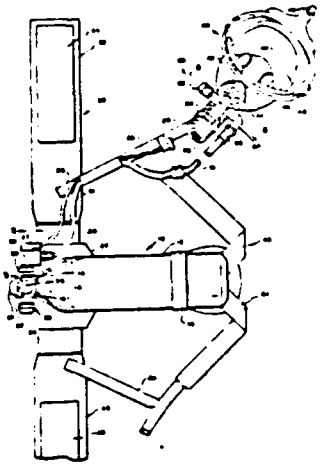
4,250,876

EMERGENCY LIFE SUPPORT SYSTEM

Max L. Kranz, Brea, Calif., assignor to Robertshaw Controls Company, Richmond, Va.

Filed Aug. 10, 1978, Ser. No. 932,535
Int. Cl.³ A62B 9/02
U.S. Cl. 128—202.22 4 Claims

1. In an emergency breathing device comprising a body harness supporting a pressured reservoir of breathable gas and a face mask with a gas supply regulator attached thereto and communicating with said reservoir by flexible hose means, and including reservoir shut off valve means having a valve body and valve member control knob carried on said reservoir and a first stage pressure reduction valve connected directly to said valve body of said shut off valve means and discharging to said flexible hose means, the improvement comprising a fluid pressure responsive audible generator and a fluid passage to apply fluid from downstream of said first stage pressure reduction valve to said audible generator, audible generator valve means in said fluid passage, resilient means biasing said audible generator valve means in a normally open position in said fluid passage and high pressure fluid passage means to apply the fluid pressure of said reservoir to close said audible generator valve means when said fluid in said reservoir is above a predetermined pressure; and wherein said gas supply regulator includes demand and pressure demand modes of operation and switch means to select one of said modes of operation; and wherein said gas supply regulator further includes a main valve



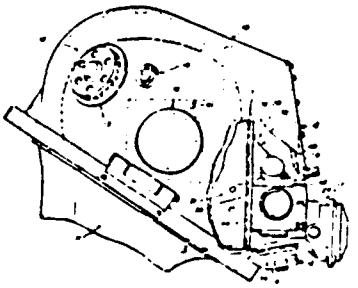
recess having a central main valve seat with flexible member supported therein and biased against said main seat, means to apply inlet gas pressure to both sides of flexible valve member, pilot valve means and gas pressure means communicating from said pilot valve means to said valve recess on the side of said valve member opposite main valve seat whereby opening and closing of said valve means moves said flexible valve member away from toward, respectively, said main valve seat.

4,250,877

DIVER'S HELMET AND FACE MASK FOR USE THEREWITH

Jack H. Owens, North Reading, and John E. Slavin, Acton, both of Mass., assignors to Morse Diving Equipment Company, Inc., Rockland, Mass.

Filed May 15, 1978, Ser. No. 906,084
Int. Cl.³ A42B 3/00; A62B 18/04
U.S. Cl. 128—207.11 17 Claims



1. In combination, a helmet provided with means to hold the head of a user in a predetermined position, a face mask consisting of first and second integral portions, the first portion hav-

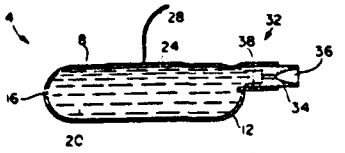
ing a cavity dimensioned to accommodate the nose of a user and to overlie his mouth, and the second portion an exposed, planar, marginal shoulder continuously surrounding the open end of the cavity, and a body shaped and dimensioned to conform generally to facial features marginally of the nose and mouth without interfering with a user's vision and provided with a planar outer surface to which said second portion is sealed, said face mask of pliant material and the body of a material sufficiently compressible to comply to the particular facial features of the user to become continuously sealed thereto when pressure is applied against the shoulder continuously about the first portion, a flat rigid plate having an aperture dimensioned to accommodate said first mask portion and shaped and dimensioned to engage said shoulder, and pressure applying means within said helmet and attached to the front thereof and in engagement with said plate on opposite sides of the cavity.

4,250,878

NON-INVASIVE CHEMICAL SPECIES DELIVERY APPARATUS AND METHOD

Stephen C. Jacobsen; Jerome C. Stenehjem; Robert L. Stephen, all of Salt Lake City, and Richard D. Luntz, Murray, all of Utah, assignors to Motion Control, Inc., Salt Lake City, Utah

Filed Nov. 22, 1978, Ser. No. 963,029
Int. Cl.³ A61N 1/30
U.S. Cl. 128—207.21 14 Claims



1. A bioelectrode for use in the iontophoretic delivery of a chemical species into the skin or tissue of a person comprising

a pouch for holding a fluid containing the chemical species, said pouch including flexible and deformable walls adapted to generally conform to surface shapes against which they are placed, at least a portion of which includes a microporous membrane separating the interior of the pouch from the exterior and having openings of about 0.22 microns or less in diameter, said portion being formed to present a generally planar to convex exterior surface, and

an electrode carried by said pouch for coupling to an electric potential source.

4,250,879

EQUIPMENT SETS AND SYSTEM FOR THE SEQUENTIAL ADMINISTRATION OF MEDICAL LIQUIDS AT DUAL FLOW RATES EMPLOYING A COMBINED AIR BARRIER AND LIQUID SEQUENCING VALVE

Andrew J. Muetterties, Gages Lake, Ill., assignor to Abbott Laboratories, North Chicago, Ill.

Filed Feb. 28, 1979, Ser. No. 16,230
Int. Cl.³ A61M 5/00
U.S. Cl. 128—214 G 20 Claims

1. A set for the sequential administration of medical liquids to a patient, comprising:

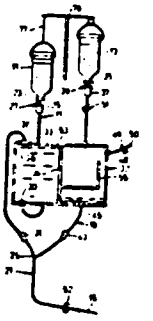
a primary tube for the flow of a primary medical liquid therethrough,

a secondary tube for the flow of a secondary medical liquid therethrough;

a common tube having its distal end in fluid communication with the proximal ends of said primary and secondary tubes and its proximal end open for the flow of liquid therefrom to form a primary liquid flow path comprising said primary tube and said common tube and a secondary liquid flow path comprising said secondary tube and said common tube,

a secondary flow control means in said secondary liquid flow path for adjusting the flow rate of said secondary liquid therethrough,

a primary flow control means on said primary tube for adjusting the flow rate of said primary liquid through said primary flow path to a rate independent of the flow rate of said secondary liquid through said secondary liquid flow path, and



a combined air barrier and liquid sequencing valve having a housing comprising a first chamber which constitutes a portion of said primary tube and has inlet and outlet ports thereto and a second chamber which constitutes a portion of said secondary tube and has inlet and outlet ports thereto,

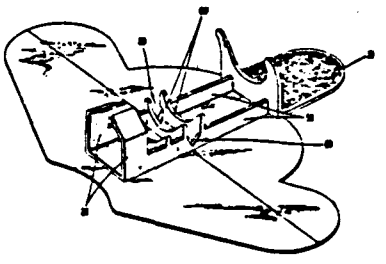
said first chamber having valve means associated therewith to control the flow of liquid through said primary tube and said second chamber having means associated therewith substantially impervious to air while said set is in use to prevent the flow of air through said secondary flow path.

4,250,880

STABILIZING FITTING FOR AN INTRAVENOUS CATHETER

Marvin Gordon, East Windsor, N.J., assignor to Whitman Medical Corporation, Clark, N.J.

Continuation-in-part of Ser. No. 5,032, Jan. 19, 1979, which is a continuation-in-part of Ser. No. 905,399, May 12, 1978, abandoned. This application Jun. 8, 1979, Ser. No. 46,803
Int. Cl.³ A61M 5/00
U.S. Cl. 128—214 R 10 Claim



1. A stabilizing fitting for securing an intravenous catheter to a patient's skin comprising a laminar base member having a longitudinal axis, an upper surface and a lower surface, pressure-sensitive adhesive means on at least a part of said lower surface of said base member, a catheter hub-retaining cradle on said upper surface of said base member, said cradle having a

said timing means including an on-off valve for starting and stopping flow, a spool valve fluidly connected to the timing means, said spool valve being moved to the open position upon receiving the oxygen flow from the valve in the timing means, a flow control device connected on its inlet side to the spool valve and to the hyperbaric chamber on its outlet side, said flow control device controlling flow into the hyperbaric chamber, a second flow line extending from the spool valve to an exhaust valve for the hyperbaric chamber, pressure control means having an inlet in communication with the pressure in the hyperbaric chamber and an outlet in communication with the spool valve whereby when the prescribed pressure is reached within the hyperbaric chamber the pressure control means closes the spool valve thereby releasing the exhaust valve so that the hyperbaric chamber pressure will be exhausted and whereby upon the return of the chamber to ambient pressure the spool valve is returned to open position for a new cycle.

4,296,744

DYNAMIC PATELLAR BRACE

Pasquale M. Palumbo, 906 Frome La., McLean, Va. 22101

Continuation of Ser. No. 949,121, Oct. 6, 1978, abandoned. This application May 27, 1980, Ser. No. 153,708

Int. Cl.³ A61F 3/00

U.S. Cl. 128—80 C 12 Claims

1. A dynamic patellar brace for preventing subluxation of a patella throughout the complete physiologic range of flexion and movement of the knee comprising:

means for bracing the patella;

means for maintaining said patellar bracing means positioned laterally of the patella throughout the complete physiologic range of flexion and movement of the knee when the brace is in use; and

means for causing said patellar bracing means positioned laterally of the patella to apply a resultant force in the medial direction to the patella throughout the complete physiologic range of flexion and movement of the knee when the brace is in use.

4,296,745

SURGICAL SEALANT COMPOSITION

Christopher D. Raymond, High Wycombe, England, assignor to G. D. Searle & Co., Skokie, Ill.

Filed Nov. 13, 1979, Ser. No. 93,351

Claims priority, application United Kingdom, Nov. 20, 1978, 45281/78

Int. Cl.³ A61L 15/00

U.S. Cl. 128—156 10 Claims

1. An adhesive surgical dressing which comprises a backing material provided on one side with a composition comprising per 100 parts, by weight, of a non-biodegradable, tacky, polymeric binding agent, selected from a group consisting of polyisoprene, polyurethane, silicone, and polyisobutylene, from 12 to 25 parts, by weight, of an inert reinforcing filler and a coating on at least the intended skin contacting face of the dressing of a non-biogradeable, water-activated polyacrylamide a hesive/thickner.

4,296,746

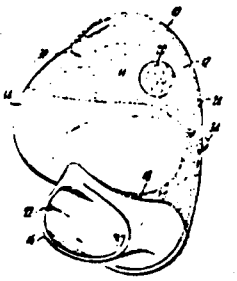
DISPOSABLE FULL-FACE SURGICAL MASK

Stanley I. Mason, Jr., Weston, and Michael D. Handler, Ri field, both of Conn., assignors to Surgikos, New Brunsw N.J.

Filed Dec. 18, 1979, Ser. No. 104,948

Int. Cl.³ A62B 7/10

U.S. Cl. 128—201.15 11 Cl



9. A comfortable, lightweight, disposable full face ... adapted to be worn without claustrophobic effect, said fa mask comprising:

a shell having an upper portion a formed of transparent plastic material having a gener oval periphery having a rim extending outwardly of t periphery at a substantial angle to the periphery;

the upper portion of the mask having vent means to disp heat and moisture, said vent means including a filtra means to prevent escape of particulate matter through vent means,

the lower portion of the mask covering the mouth of wearer and having a region comprising an air filtra medium which is an effective bacterial filtration medi

a strip of soft, flexible material fixed to said rim along periphery and extending inwardly of said rim; and

means for securing said face mask on the head of the wear such that, when said mask is worn, said strip is hinged flexed and lightly compressed against the head of a wear with said shell covering the face of a wearer but po tioned from a wearer's face.

4,296,747

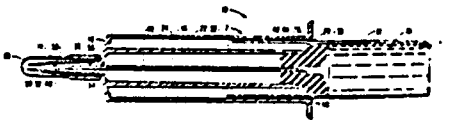
CATH-A-JET

Robert W. Ogle, Newport Beach, Calif., assignor to IMS L ited, El Monte, Calif.

Filed Feb. 11, 1980, Ser. No. 120,532

Int. Cl.³ A61M 5/00

U.S. Cl. 128—220 5 Cl



1. A device for introducing fluid into catheters of the ... which are partially receivable in the human urethra to d urine from the bladder and have a free end fitment and ... pierceable injection site, comprising:

syringe means actuable to expel fluid from an outlet at end thereof;

connector means extending from said one end of the sy

VENDORS

Seal Material

Bose Corporation
The Mountain
Framingham, MA 01701-9168

Donzis Research Incorporated
3008 Rogerdale Rd.
Houston, TX 77042

Dow Corning
Dept. A-6019
Midland, MI 48640

Spenco Medical Corporation
P.O. Box 2501
Waco, TX 76702

Attachment Mechanisms

Alpina,U.S.A.
21 Industrial Drive
Esmond, R.I. 02917

Breathing Systems Incorporated
15100 Lee Road Suite 106
Humble, TX 77396

Electro-Seal Corp.
55 Wanaque Avenue
Pompton Lakes, New Jersey 07442

Homa Locks Inc.
39 Shelter Rock Road
Danbury, CT 06810

Sunbrand & Pfaff
A Division of Willcox & Gibbs, Inc.
1440-T Broadway
New York, N.Y. 10018

Survivair, Comasec Inc.
3001 S. Susan St.
Santa Ana, CA 92704

U.S. Divers, Aqua-Lung
3323 W. Warner Ave. P.O. Box 25018
Santa Ana, CA 92799-5018

Uvex Winter Optical, Inc.
10 Thurber Boulevard
Smithfield, R. I. 02917

Vertrod Corporation
2041 Utica Ave.
Brooklyn, N.Y. 11234

APPENDIX B

DONZIS PATENTS PERTAINING TO PNEUMATIC SEAL PROTOTYPE

United States Patent [19]

Donzis

[11] **Patent Number: 4,874,640**

[45] **Date of Patent: Oct. 17, 1989**

[54] **IMPACT ABSORBING COMPOSITES AND THEIR PRODUCTION**

[76] Inventor: **Byron A. Donzis, 28 E. Rivercrest Dr., Houston, Tex. 77042**

[21] Appl. No.: **141,592**

[22] Filed: **Jan. 7, 1988**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 99,368, Sep. 21, 1987, abandoned.

[51] Int. Cl.[4] **B05D 1/18; B05D 1/02**

[52] U.S. Cl. **427/421; 427/430.1; 5/481; 36/37; 36/92**

[58] Field of Search **427/430.1, 421; 2/2, 2/22; 264/46.6, 46.8; 5/434, 481, 483, 473; 36/37, 89, 92, 71, 81, 82, 138, 44**

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,626,886	1/1953	Scholl	427/421 X
3,707,434	12/1972	Stayner	427/421 X
4,347,205	8/1982	Stewart	427/430.1
4,663,226	5/1987	Vajs et al.	427/421 X

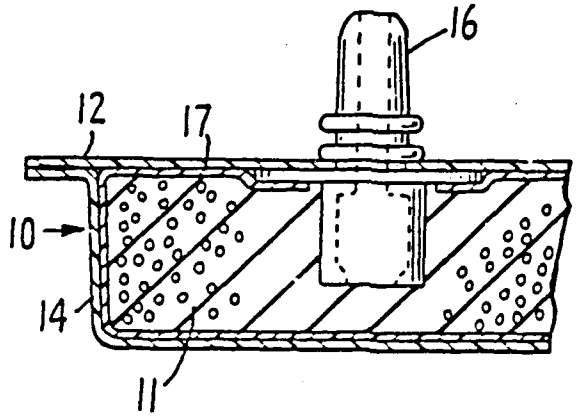
Primary Examiner—Shrive Beck

Attorney, Agent, or Firm—Pravel, Gambrell, Hewitt, Kimball & Krieger

[57] **ABSTRACT**

An improved composite for absorbing and dispersing impacting forces is disclosed. The composite includes a flexible plastic enclosure defining an internal cavity. The flexible enclosure is generally impermeable to air and capable of having its internal pressure changed. The composite further includes a foam core filling the cavity and retained within the cavity and adhered on substantially all of its external surface to the internal surface of the cavity. The cavity can be pressurized for higher impact absorbance. Methods for fabricating the composites are disclosed, as well. These methods include forming the outer enclosure by applying a solution/suspension of the prepolymer of controlled solids content to the core and also can include the step of preheating the core prior to coating it.

10 Claims, 5 Drawing Sheets



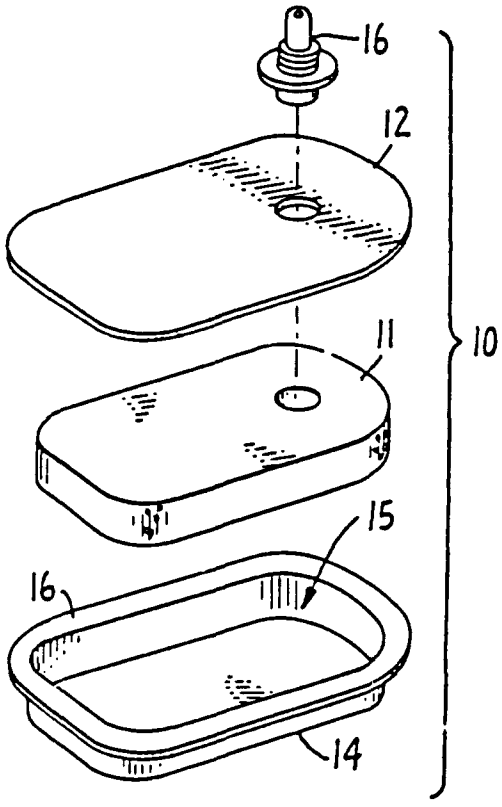


FIG. 1.

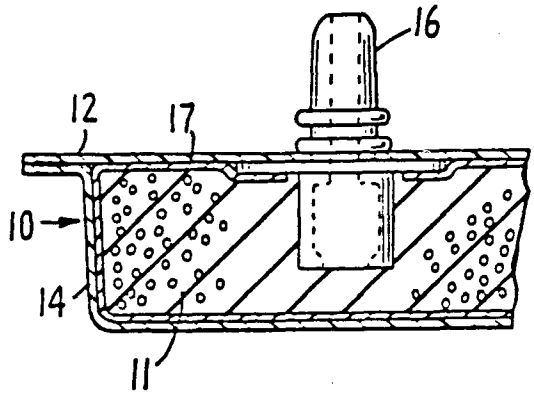
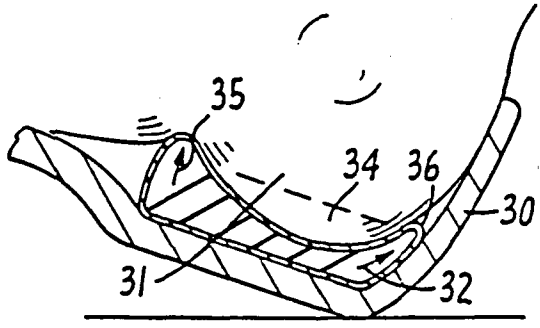


FIG. 2.



(PRIOR ART)

FIG. 3.

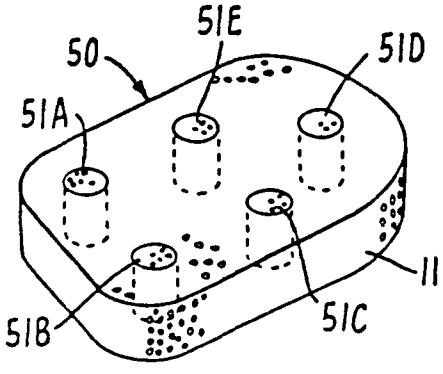
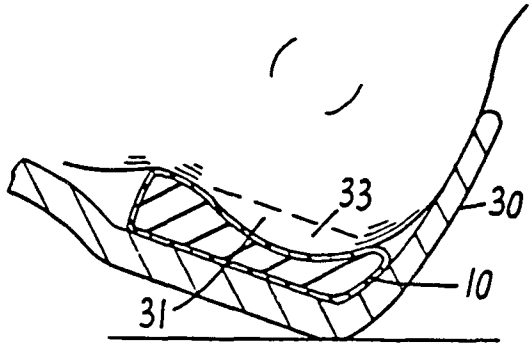


FIG. 5.



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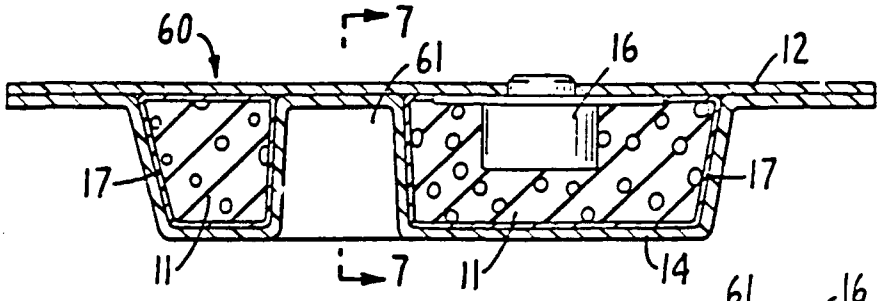

FIG-.6

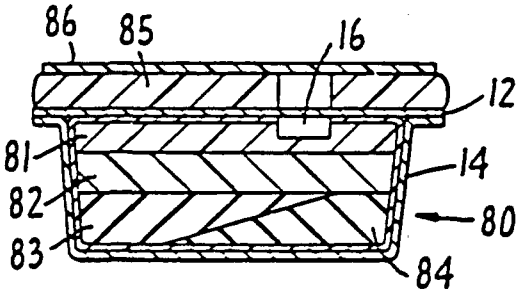

FIG-.3.

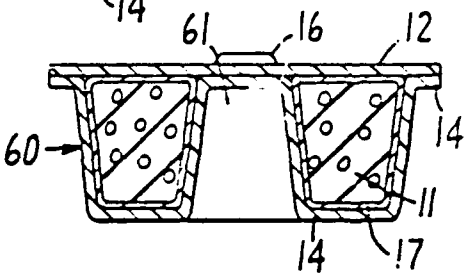

FIG-.7.

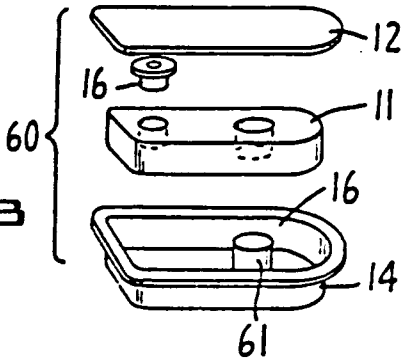

FIG-.8

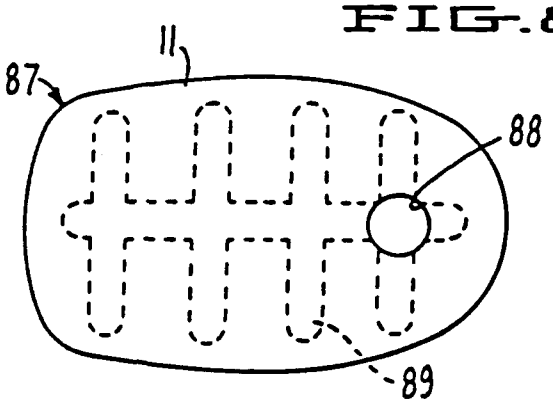

FIG-.10.

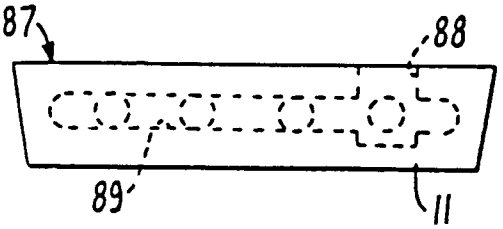

FIG-.11.

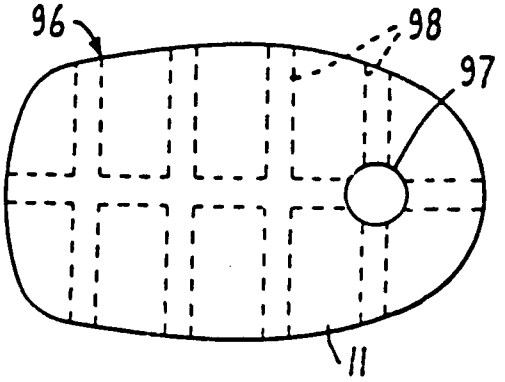

FIG-.12.

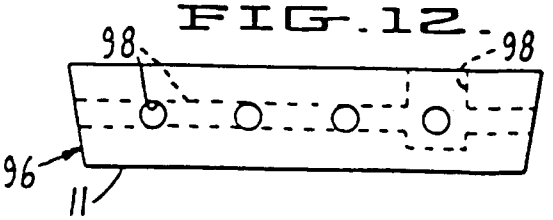

FIG-.13.

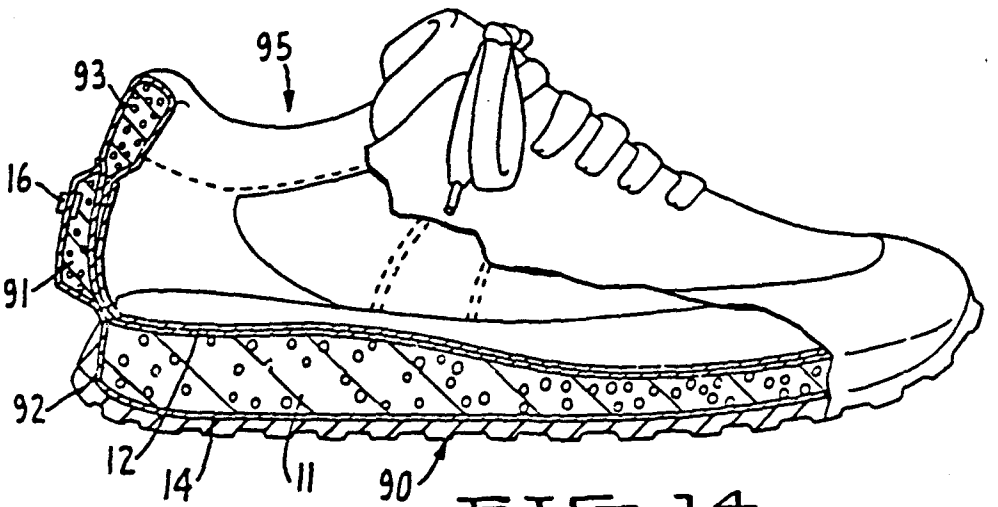

FIG. 14.

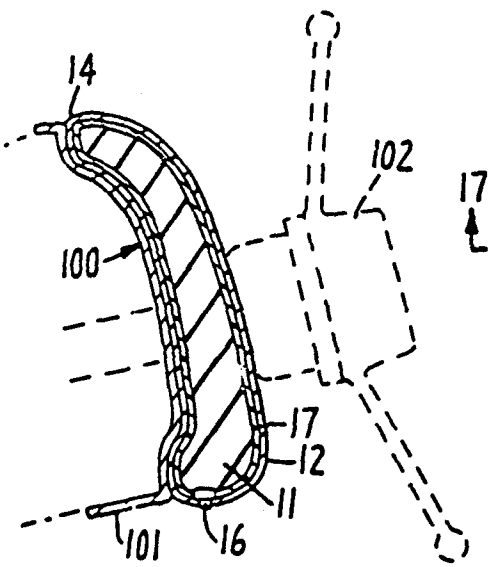

FIG. 15.

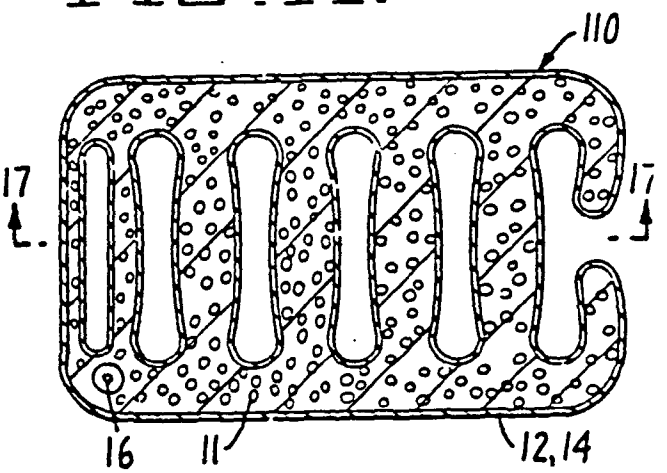

FIG. 16.

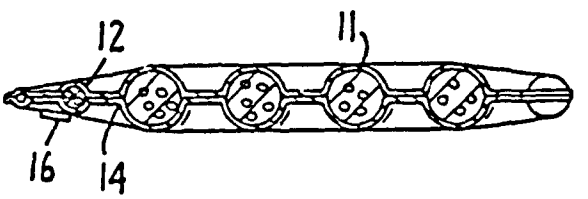

FIG. 17.

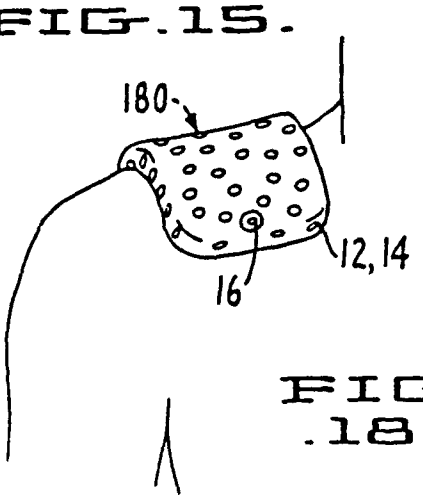

FIG. 18.

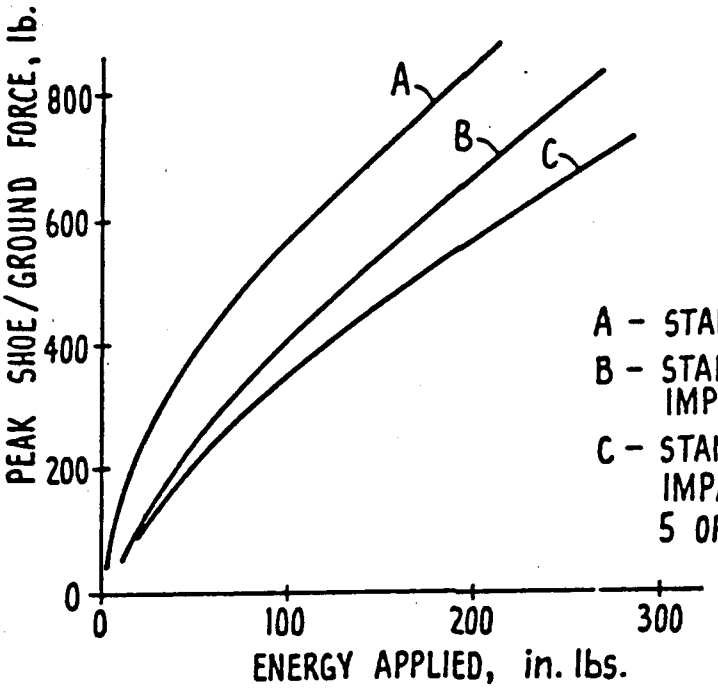

FIG-19.

A - STANDARD SHOE
B - STANDARD SHOE PLUS IMPACT ABSORBER
C - STANDARD SHOE PLUS IMPACT ABSORBER AT 5 OR 10 lbs/sq. inch. PRESSURE

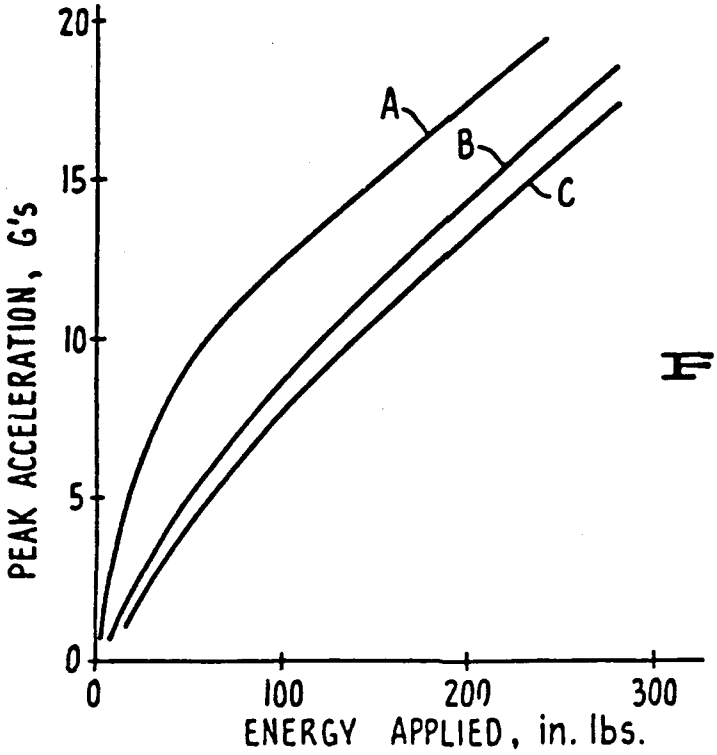

FIG-20.

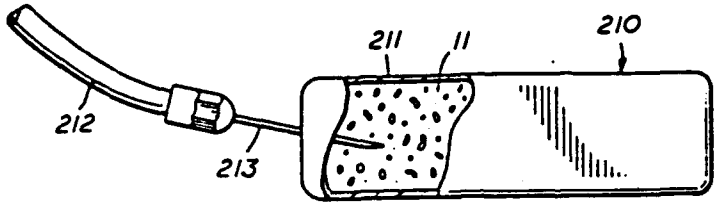

FIG. 21

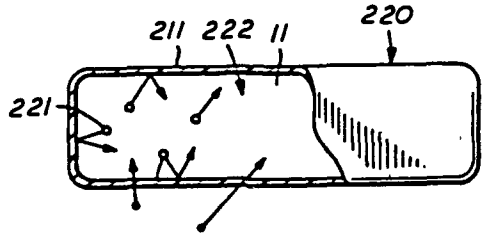

FIG. 22A

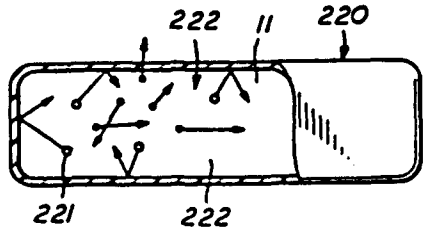

FIG. 22B

IMPACT ABSORBING COMPOSITES AND THEIR PRODUCTION

This is a continuation-in-part of U.S. patent application Ser. No. 099,368, filed Sept. 21, 1987. This application is also related to U.S. patent application Ser. No. 127,145, filed Dec. 1, 1987, now abandoned as a continuation-in-part of Ser. No. 099,368.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improved impact absorbing compressible composites. These composites which are described in the above-noted parent application can be shaped into smooth compound curves and find application wherever high efficiency impact absorption is called for such as in athletic wear, in seating systems, in vehicle interior padding materials and the like. More particularly, the present invention relates to improvements in the production of these composites.

2. Background Information

There is a well-recognized need for high performance materials for spreading or absorbing impacts. In recent years, athletes, athletic equipment manufacturers and sports medicine professionals have recognized the need for improved impact absorbing materials in athletic equipment. These materials find application as heel pads and foot sole pads in shoes to absorb the shock of foot strike and as cushioning points under football or hockey pads such as shoulder pads, thigh pads, hip pads and the like to name but a few typical applications. Similar needs may be found in seating systems and in vehicle interiors, to name but a few representative fields in which impact absorption is a major interest.

One common approach to impact absorption in the past has involved using felts or blocks of a soft padding matenal. Padding materials known heretofore include cotton padding, horsehair padding, foam rubber, foamed plastics, sponge rubber and the like. In these designs, the inherent resilience of the padding material is employed to absorb and disperse the applied impact. These designs have the disadvantage that they often "bottom out" or fully compress on severe impacts of the type regularly encountered during use such as in athletic equipment or in vehicle interiors and thus provide minimal protection. When made thicker to avoid this problem, they become cumbersome and can interfere with the design of the article being padded and in the case of athletic equipment can interfere with the wearer's freedom and performance.

Impact absorbers have also been proposed which employ fluid-filled bladders such as cushioning air sacks These devices rely upon the compressibility of the enclosed fluid to provide the desired shock-absorbing. In some embodiments of these devices, tne fluid is fully enclosed and can not escape In others, the fluid is gradually and controllably forced out of the bladder during the impact with the rate of release being selected to prevent exhaustion of the fluid during thc impact event. While effective as shock-absorbers, these devices can have the failing of ballooning or otherwise expanding in one region when another region is being compressed. This can lead to discomfort or at minimum give an unnatural or unstable feel to the user. In the case of footwear, this problem can lead to an unstable foot plant with increased opportunity for injury. Another issue with this type of pad has related to problems in forming

shapes based on compound curve and to retaining structural integrity with the above-described ballooning

Representative patents in the field of shock-absorbing or impact absorbing devices include U S Pat. No 4,513,449, SHOCK ABSORBING ATHLETIC EQUIPMENT; U.S. Pat. No 4,370,754, VARIABLE PRESSURE PAD; U.S. Pat. No 4,453,271, PROTECTIVE GARMENT; U.S. Pat. No. 4,217,705, SELF-CONTAINED FLUID PRESSURE FOOT SUPPORT DEVICE, all issued to Donzis, U.S. Pat. No. 4,446,634 for FOOTWEAR HAVING IMPROVED SHOCK ABSORPTION; U.S. Pat. No. 4,397,104 for INFLATABLE SOLE-SHOE, U S. Pat. No. 2,863,230 for CUSHIONED SOLE AND HEEL FOR SHOES; U.S. Pat. No. 4,229,889 for PRESSURIZED POROUS MATERIAL CUSHION SHOE BASE; U.S Pat No 4,637,716 for METHOD FOR MAKING ELASTOMERIC SHOE SOLES; U.S. Pat. No. 4,635,384 for FOOTWEAR SOLE; U.S. Pat. No. 4,610,099 for SHOCK-ABSORBING SHOE CONSTRUCTION, and U.S. Pat. No. 4,571,853 for SHOE INSERT.

It is an object of the present invention to provide an improved impact absorbing composite It is desired that this composite provide superior shock-absorbing performance and also be capable of being formed into complex compound curve shapes, be durable and hygienic.

It is an additional object of this continuation- in-part application to provide and claim additional improved embodiments of this invention relating to the method for their production which fall within the general teachings of the parent application.

STATEMENT OF THE INVENTION

An improved impact absorbing composite has now been found. This composite is capable of dispersing and absorbing impacting forces with high efficiency. The composite is characterized by a structure including a flexible plastic wall (enclosure) defining an internal cavity. This flexible enclosure is made of a material that is generally impermeable to the gas such as air or a large molecule gas which it encloses and is capable of having its internal pressure changed. The internal cavity of the enclosure is filled with a foam core. This core is held in place by the cavity walls. Importantly, the core is intimately adhered (glued, bonded or the like) on substantially all of its external surfaces to the internal surface of the cavity. In preferred embodiments, the wall and the core are prestressed by one another. That is, the core presses out against the wall and the wall pushes in against the core. The intimate adherent contact between the foam core and the outer wall gives rise to an unexpected degree of product integrity and unexpectedly superior impact absorbing capabilities.

In some preferred embodiments, the composite has a valve or fitting communicating with the cavity so that the pressure within the cavity can be altered. Alternatively, the cavity can be pressurized by injecting fluid through the wall and sealing the injection orifice. This permits the composite to be adjusted to accommodate varying impacts. The invention can thus include in combination such a composite together with a device for pressurizing its cavity. In other preferred embodiments this fitting can be removable after pressurization has been completed or the pressurization can be effected by the use of diffusion pumping.

Also in preferred embodiments, the foam core is an open-celled foam or a reticulated foam so that the pressure within the core is uniform Urethane polymers

have been found to be excellent for forming the cavity and the foam and are preferred materials of construction.

In other aspects, the composites of the invention can employ cores having a plurality of different foams arranged parallel or perpendicular to the impact direction. This permits differing densities and impact resistances to be present at different positions on the composite. The impact absorbers of this invention can be used in conjunction with other materials or layers including without limitation, cosmetic or hygienic overlayers, other shock-absorbing layers or the like.

In yet another aspect, this invention provides a variety of methods for fabricating these composites. All of these methods are characterized by creating an adherent bond between the foam core and the outer layer and by pressurizing the core to a value effective to provide efficient impact absorption.

One such method involves shaping the wall surface to create a cavity, sizing and shaping the foam core so as to fully fill the cavity and preferably prestress the wall and core, adhering and enclosing the core within the cavity and adjusting the pressure within the cavity to a value effective to provide efficient impact absorption.

Another fabrication method involves shaping the wall surface to create a cavity, sizing and shaping the core so as to partially fill the cavity, placing the core within the cavity, forming an elastomeric foam and preferably an open-celled or reticulated foam in situ within the cavity so as to fill the space between the preshaped foam and the cavity wall and to adhere the cavity wall to the core and preferably prestress the wall and core, and adjusting the pressure within the cavity to a value effective to provide efficient impact absorption.

Yet another fabrication method involves shaping the wall surface to create a cavity, forming a cavity-wall-adherent open-celled or reticulated foam core in situ within the cavity so as to fill the cavity and preferably prestress the wall and core, and adjusting the pressure within the cavity to a value effective to provide efficient impact absorption.

A further fabrication method involves sizing and shaping the foam core, forming the outer wall in situ around and adherent to the foam core such as by shrinking a film a core-adherent material around the core or by applying a layer of uncured wall material, such as a solution of wall-forming polymer, around and adherent to the core and then curing the uncured wall material, thereby creating a cavity enclosing and preferably prestressing the core, and adjusting the pressure within the cavity to a value effective to provide efficient impact absorption. In a preferred embodiment of this process in which the wall is formed in situ around the core, the wall-forming polymer is employed as a viscous solution that is sprayed over the core with the number of coats of sprayed material being selected to yield an outer wall of appropriate thickness.

The present invention particularly involves two processing variants for forming the outer wall in situ. In one variant, the wall is formed by dipping a foam core in fluid uncured (prepolymer) wall material and thereafter curing the wall material. In this process it is essential that the wall forming phase be a very high solids content suspension. It has been found, that if this is done, unexpectedly, the core, especially in its preferred open cell form, does not adsorb (soak up) and become saturated with excess wall-forming material. Preferably the wall-forming material is from about 50 to about 85% solids, although at the high end of this range the material may be too viscous to flow well. More preferably the wall-forming material is from about 50 to about 75% solids.

In the other variant for forming the outer wall in situ, it has been found that in cases where the wall-forming material is applied to the core, either by spraying or dipping, a better product results if the core is preheated to a temperature above ambient prior to application of the wall-forming material. This elevated temperature is preferably from about 80° F. to about 250° F. and more preferably from about 90° F. to about 150° F. This elevated temperature has the effect of minimizing adsorption of the liquid phase into the foam core.

The present shock-absorbing composites can be employed in a wide range of applications. One excellent application is as heel pads and/or sole pads for shoes, especially sport shoes, where they serve to absorb foot strike impact with high efficiency.

The composites of this invention are characterized by being easily formed in compound curve forms, by being very light weight and by being hygienic. They are further characterized by being adjustable in pressure, and thus in impact cushioning capacity. This permits them to serve in a wide range of applications with widely variable impacts.

DETAILED DESCRIPTION OF THE INVENTION

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described herein with reference being made to the accompanying drawings. Where practical in the drawings, a common reference numeral is used for the same part when it appears in more than one Figure. In the drawing:

FIG. 1 is an exploded perspective view of the components of an impact absorber of this invention;

FIG. 2 is an cut away cross-sectional view of a shock-absorber of this invention;

FIG. 3 is a partially schematic cross sectional view of an impact absorbing heel pad not embodying this invention. This heel pad has a wall defining a pressure-tight cavity but does not have a foam core adhered to and filling its inner surface. This figure illustrates the flaw in this design that an impact can be absorbed but, at the same time ballooning occurs;

FIG. 4 is similar to FIG. 3 but illustrates that with the present invention ballooning is prevented;

FIG. 5 is a perspective view of an alternative foam core for use in this invention. This core has a plurality of differing compression strength foams arranged parallel to the impact force;

FIG. 6 is a cut away cross-sectional view of another alternative embodiment of the impact absorber of this invention in which the wall material defining the cavity is further shaped to provide a supportive column;

FIG. 7 is another cross sectional view of the absorber shown in FIG. 6 taken along line 7–7';

FIG. 8 is an exploded perspective view of the components of the absorber of FIGS. 6 and 7;

FIG. 9 is a perspective view of an alternative embodiment of the impact absorber of this invention. This embodiment employs a core which has a plurality of differing compression strength foams arranged perpendicular to the impact force;

FIG. 10 is a phantom top view of a core configuration for use with closed cell foam materials;

FIG. 11 is a cross sectional view of the core shown in FIG. 10 taken along line 11-11';

FIG. 12 is a phantom top view of another core configuration for use with closed cell foam materials;

FIG. 13 is a cross sectional view of the core shown in FIG. 12 taken along line 13-13';

FIG. 14 is a cut away cross sectional view of a shoe containing a shock-absorber of the present invention and additionally having a pump for pressurizing the core of the absorber;

FIG. 15 is a cross sectional view of an automotive dash board incorporating an impact absorber of this invention;

FIGS. 16 and 17 are two views of an additional representative application for the shock-absorbers of this invention as a foot pad;

FIG. 18 is a perspective view of a shoulder pad under pad application for the shock-absorbers of this invention;

FIGS. 19 and 20 are graphs illustrating the effectiveness of the impact absorbers of this invention and their adaption to various body weights and to various impacts;

FIG. 21 is a partially cross-sectional view of a shock-absorber of this invention employing an alternative pressurization modality and an alternative wall-forming technique; and

FIGS. 22A and 22B are partially cross-sectional views of two stages of pressurization of a shock-absorber of this invention employing a diffusional pressurization modality.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2 in more detail, these figures illustrate an impact absorber 10. Impact absorber 10 includes a foam core 11 and top and bottom wall sections 12 and 14 which when joined define a cavity 15. A layer of adhesive 16 is present between essentially all of the inner surface of cavity 15 and the outer surface of foam core 11. This layer is shown on core 11 but could as well be on the inside surface of the wall or on both the core and the wall as desired. When wall sections 12 and 14 are joined, the cavity which they define is pressure tight. It is possible to equip the impact absorber with a valve or fitting such as valve 16. Valve 16 is a "Halkey-Roberts" type urethane valve which is shown in FIG. 1 in its pre-assembly form. After incorporation, the top end of valve 16 is cut off flush with the surface of the shock-absorber as shown in FIG. 2. Any equivalent form of valve, pressure control aperture or other means to increase the pressure within the cavity can be used, if desired. This valve allows the pressure in the interior (cavity 15) of the impact absorber to be adjusted, as desired, by adding or removing fluid from the cavity.

The outer wall of the impact absorber is formed of flexible plastic. The materials used to form the wall can be selected from the film-forming flexible plastics. Virtually any plastic can be used so long as it is resistant to bacterial attack, flexible and shapable into the forms and configurations desired. Useful film-forming plastics include poly(urethane)s both of the poly(ether) and the poly(ester) form, poly(ester)s such as poly(ethylene terphthalate), flexible poly(vinyl)s, elastomeric poly(olefin)s such as poly(isoprene), poly(isobutylene), and neoprene, low density poly(ethylene)s and the like.

In the embodiment shown in FIGS. 1 and 2, the outer wall is preshaped into the desired configuration and then the foam core is adhered to it. In another embodiment, the outer wall can be formed around the foam core. One way to accomplish this is to use a liquid polymer precure solution or suspension which is applied to the outer surface of the core and then cured. It has been found that this method has advantages when the solution or suspension is sprayed onto the foam. Since the foam employed herein is preferably of open-cell construction, it has been found that the use of spraying allows a coherent outer film to be achieved without soaking the foam with excess solution or suspension. Another way to accomplish this is to use plastic sheet stock and laminate it to the core or shrink it around the core. In any of these alternative modes of construction, it is essential that there be a strong adherent bond between the wall and essentially the entire outer surface of the core.

Of the plastics useful in forming the films, preference is given to the flexible poly(urethane)s because of their ready availability. These materials are available from J. P. Stevens Company and Deerfield Urethane,Inc., to name but two regular suppliers. Representative useful plastic films include the Deerfield "Dureflex" poly(urethane) films. These materials can be preformed, as in FIGS. 1 and 2 or they can be used as stock goods. When a liquid is used to apply the outer wall, it is typically a solution of a prepolymer or resole resin. Vinyl films can be used in this application. A typical vinyl film is the vinyl adhesive sealant produced by W. R. Grace and marketed by Eclectic Products as Eclectic 6000 adhesive sealant. These materials are solvented in halocarbons such as perchloroethylene and the like. A preferred liquid coating is based on the polyurethanes. Again, the nonrigid urethane polymers are preferred. The solutions known in the art for forming flexible urethane films are very suitable for this application. Typical urethane polymer solutions include the reaction product of a diisocyanate such as toluene diisocyanate or hexamethylene diisocyanate with a polyol such as a poly(ether polyol). These reaction products are commonly produced in a mixed solvent system such as a polar solvent (for example, Butyl Cellosolve, Cellosolve Acetate, butyl Carbitol, or diacetone alcohol or the like) in combination with an aromatic solvent such as toluene, benzene, or hydrocarbon distillate fractions heavy in aromatics and having a boiling range in the range of from about 140° to 240° C. In preferred applications, the fluid film-forming material is sprayed onto the foam so as to minimize soak in and build up. In this case, it is preferable to use a relatively viscous, high solid content suspension/solution. Typical viscosities are 100 cps or greater such as us to about 1,000 cps. Typical solids contents are from about 25% to about 60%. Materials outside of these ranges can be used but the above ranges are preferred.

In one preferred application, the liquid film forming material is applied to the foam by dipping. In this case it is preferable to use a high solid content suspension/solution. Preferably, the suspension/solution shall contain at least about 50% by weight solids and more preferably from about 50 to about 75% by weight solids. Such solution/suspension has the advantage of not soaking into the foam core even when the foam core is open celled construction.

This outer wall, when applied as a liquid can be dried (solvent removed) and cured by the application of heat

and/or the application of a curing catalyst such as an amine. Other curing modalities such as photocuring can be employed as well, if appropriate. The liquid wall-forming compositions can contain plasticizers and builders and the like, if desired. The particular conditions used for forming the outer wall are conventional for processing polymers such as the urethanes which are preferred and are known to those of skill in the polymer arts.

In those applications where the outer wall is applied as a liquid, either by dipping or by spraying, it can be of advantage to preheat the foam core. This preheating raises the temperature of the foam core to above ambient, that is preferably above 80° and more preferably above 90° and up to the highest temperature at which the foam core remains thermally stable. Such high temperatures include 250° F. or higher if possible. Preferred temperatures are from about 90°-250° F. and especially from about 100°-50° F. This preheating of the core appears to assist the formation of a film when the liquid wall-forming material is applied. These elevated temperatures can be achieved by autoclaving the core prior to applying the outer material.

The outer wall, whether supplied as a preformed structure, a cured liquid overcoat or a shrunk or adhered layer of stock goods is commonly from about 1 to 200 mils in thickness with thicknesses in the range of from about 2 to 50 mils being preferred and excellent results being attained with thicknesses of from about 3 to about 35 mils.

The core of the impact absorber is a foam. This foam is preferably an open-celled foam, that is a foam in which the various cells are in communication with each other and with the outer surface of the foam. Similar properties are achieved with a *reticulated foam*, that is a foam which has been treated to break down membranes which separated various cells. Foam rubber, foamed latex, vinyl foams and the like can be used. The preferred foam material for use in the core is poly(urethane) foam. Representative foams include the "Ensolite" foams sold by Uniroyal Plastics Co., Inc. and the flexible urethane foams sold by the E. R. Carpenter Company.

Typical densities for the foam core range from between about 0.5 to about 15 pounds per cubic foot. Preferred foam densities are from about 2 to 10 pounds per cubic foot.

It will be appreciated that because the foam core is adhered to the outer wall it is in effect a structural member. The adhered foam serves to prevent the ballooning of the device as previously described. This duty puts strain upon the foam of the core. If the foam separates under this strain it can result in a loss of integrity of the device. With this potential problem in mind, it is possible to reinforce the foam by including filaments or fibers or fabrics in it. Typical reinforcements can be inorganic materials such as fiberglass or carbon fiber; natural organic fibers such as silk, cotton, wool or the like or synthetic organic fibers such as urethane fibers, nylon filaments, nylon fabrics, aramid filaments and fabrics, and the like. This reinforcement can be laminated into the foam, incorporated into the foam or otherwise compounded into the foam as is known by those skilled in the art.

In the embodiment shown in FIGS. 1 and 2, the internal foam core is preshaped to fit tightly within the outer wall of the impact absorber.

This intimate fit may be accomplished in other ways as well. For one, the core can be foamed in place within the wall structure using injectable flexible foam forming materials known in the art. With the preferred urethane foams, a typical foaming mixture can include a polyether polyol, a diisocyanate such as toluene diisocyanate, water, and amine and organotin catalysts. This mixture generally contains polymeric fillers and flexibilizers (plasticizers) as well. The added water reacts with the isocyanates to produce an amine plus carbon dioxide gas which foams the liquid. Other foaming agents such as gases including carbon dioxide, nitrogen, air or the like as well as low boiling liquids, (commonly low-boiling fluorocarbons and the like) can also be added. By controlling the amount of foaming material added and the cure conditions, the core so formed can, if desired, prestress the outer wall as is preferred. The in situ cores can be closed-cell foams, open-celled foams or reticulated foams as desired.

In a hybrid form of construction, the foam core can be a composite of a preshaped foam body which does not completely fill the cavity created by the outer wall and an added foam-in-place layer between the wall and the preshaped body. This form of fabrication has the advantage that the desired intimate fit is achieved with a minimum of preshaping and fitting while at the same time the preshaped core provides a measure of dimensional stability and integrity to the composite during fabrication.

The third component of the impact absorbers of this invention is an adhesive for affixing the foam core to the wall. This adhesive is most conveniently an activated adhesive such as a light activated adhesive UV activated adhesive or heat activated adhesive so as to permit the parts to be fitted together and then bonded. A typical heat-activated adhesive is the Royal Adhesive DC-11324 material sold by Uniroyal. This adhesive is a two part poly(urethane)/isocyanate adhesive which has the added advantage of being water-based. When applied to the foam and/or wall it dries to a non-tacky surface which permits easy assembly. This material heat-activates at 300°-325° F. to form a tough adherent bond. Other useful adhesives can include epoxy adhesives, contact cement type poly(urethane) adhesives such as the Uniroyal "Silaprenes", the 3M "Scothgrip" adhesives and the isoprene contact cements. In general, one can employ as adhesive any material which will bond the foam to the outer wall with a strength which will not be exceeded by the forces of impact applied to the impact absorber or by the forces applied by the pressure applied to the impact absorber.

In the fabrication methods in which a liquid solution of prepolymer is applied to the core to create the outer layer or in which the core is foamed in place, it is often the case that the required intimate bond between the core and the outer wall is formed directly without the need for added adhesive.

The outer wall portions of the impact absorber are joined together such as by the use of adhesive or by heat sealing or the like to give a fluid impermeable wall to which the inner core is bonded. After the fusing together of the wall components, the impact absorber can be trimmed and, if desired, further shaped to conform to the environment of use.

The core of the present impact absorbers contain a fluid. Gases and in particular air are very suitable fluids. Liquids and gells could be used as well, if desired. One interesting class of fluids for use in inflating [illegible]

shock-absorbers are the gases denominated the "supergases" by Marion Rudy in his U.S. Pat. No. 4,219,945 FOOTWEAR. These gases are large molecule gases such as the heavily substituted halocarbons, for example hexafluoroethane, perfluoropropane, perfluorobutane, perfluorohexane, perfluoroheptane, octafluorocyclobutane, hexafluoropropylene, tetrafluormethane, 1,2-dichlorotetrafluorethane, 1,1,2-trichloro-1,2,2-trifluorethane, bromotrifluoromethane and the like. These gases have the property of being preferentially retained within elastomeric membranes through which air, nitrogen, oxygen and other "smaller" molecules can diffuse. This leads to the interesting phenomenum that these smaller molecules of gas can, with the passage of time, diffuse into the cavity created by the polymeric wall and filled with the supergases and thus increase the observed pressure within the cavity.

Turning to FIGS. 3 and 4, the advantages of the impact absorber of this invention are graphically illustrated. In each of these figures a shoe 30 is shown together with foot 31 impacting downward into a heel pad shown as 32 (in FIG. 3—not according to the invention) and as 10 (in FIG. 4—in accord with this invention). In the case of heel pad 32, the downward pressure of the heel causes the center of the pad 34 to be severely depressed while permitting the edges 35 and 36 to balloon up. This can be uncomfortable and unstable. With pad 10 the center 33 depresses somewhat but there is minimal ballooning.

Turning now to FIG. 5, a variation of the core 11 is shown. This core (core 50) is fabricated from a plurality of foams of differing properties, for example density. As shown, the core includes a series of plugs 51A, 51B, etc of firm density foam inserted into the body of core 11. This can result in a light weight core having the firmness of the plugs. This is merely a representative configuration and one could as well have one entire section of the core with one density foam and another section with another density. One could also vary the core based on other properties, such as the ability of a region of the foam to take a set or the like. The various core sections are adhered to the outer wall of the impact absorber as is shown in FIGS. 1 and 2. One could form a core of this type by placing preshaped pieces of one foam in the cavity and then foaming in place the other material, if desired.

The plastic wall of the impact absorber can have structural properties and contribute to the rigidity and shock-absorbing properties of the device. FIGS. 6, 7 and 8 illustrate an embodiment 60 of the impact absorber which includes a depression or "column" 61 in its structure so as to provide additional wall surface and structure in that region of the absorber. In this embodiment as shown in FIG. 8, the valve 16 is illustrated being laminated into the composite as the top 12 is joined to the bottom 14.

FIG. 9 illustrates other variations which may be employed without departing from the spirit of this invention. FIG. 9 shows impact absorber 80. The foam core of absorber 80 is fabricated from several different foams including foam section 81, section 82, section 83 and section 84. These sections are all adhered to the wall 12/14. Valve 16 is again provided to permit the pressure of the core to be altered and controlled. The various core sections can be adhered to one another, if desired. If they are adhered to one another, it must be borne in mind that the glue layers or the like between the various sections can [illegible] barriers for the transport of fluid between the various sections. If such fluid communication is desired, gaps must be left in the glue layers or glues which are fluid-permeable must be used.

Absorber 80 includes several other features which can be incorporated into the present absorbers. An exterior pad 85 is provided. This can provide additional shock-absorbancy. A top layer 86 is also present. This can be a cosmetic over layer or can be provided as a replaceable hygienic layer.

In the absorbers shown in FIGS. 1, 6 and 9, the means for adjusting the pressure (valve 16) has been in communication with the foam core itself and has relied upon the open-cell foam structure of the core to distribute the applied pressure throughout the core and thus provide a uniform level of support throughout the absorber. While this structure is very suitable, one can also employ closed-cell foams, if desired. FIGS. 10 and 11, and FIGS. 12 and 13 respectively illustrate two representative configurations for a closed-cell foam core. In the configuration shown in FIGS. 10 and 11, the core 87 contains an aperture 88 into which the pressure adjusting valve 16 can fit. This aperture 88 communicates with a network of channels 89 spaced throughout the core so as to transmit and distribute the pressure applied to aperture 88. In this embodiment, the network of channels is contained by and enclosed by the closed-cell foam core. This means that the core itself can contribute to the containment of the pressure applied to the channels. This offers the advantage that localized stress on the outer wall is avoided or minimized and possible failures due to rupture at localized stress points are minimized.

The configuration shown in FIGS. 12 and 13 is substantially the same as that shown in FIGS. 10 and 11 with the exception that aperture 97 communicates with a network of passages 98 which are not fully contained within the core. This configuration does not offer the localized stress relief of the configuration of FIGS. 10 and 11 but would be less expensive and simpler to produce.

Turning to FIG. 14 an additional embodiment of the impact absorber is shown as foot pad 90 housed within the sole portion of shoe 95. Foot pad 90 includes the foam core 11 and adherent outer wall 12/14 described herein. Pad 90 is equipped with a built in pump to alter the pressure within its core. This pump includes a one way check valve 16 which admits air into pump cavity 91. Pump cavity 91 is compressed and released to give a region of low pressure so that air can enter through valve 16. When the cavity 91 is depressed again, this forces the newly admitted air through passage 92 into the core 11, thus increasing its pressure. This process is repeated until the proper pressure is attained. Shoe 95 also includes a collar 93. This can be formed with the same structure as pad 90 with an internal core adhered to the walls. Such a collar would be very effective at absorbing the shock which would occur as the wearer's foot comes up in the shoe and impacts it or would be effective as a protection to the wearer's ankle and achilles tendon region.

FIG. 15 illustrates that the present invention finds application in many areas beyond athletic equipment. It illustrates an automotive dashboard structure 101 having an impact pad 100 on its face as well as phantom steering wheel 102. Impact pad 101 includes core 11, wall 12/14 and valve 16. Such a pad can provide efficient dashboard impact protection or the occupants of the automobile in the event of a crash.

FIGS. 16 and 17 illustrate in two views a ventilated footpad 110 for use in shoes. Pad 110 has a complex shape which requires numerous compound curves. In its application as a shoe footpad, pad 110 will be subjected to a wide variation in impacts depending upon the weight of the runner using it and the runner's lightness of footstrike. It is of substantial advantage to adjust the pressure within the pad with valve 16 to accommodate these variations.

FIG. 18 illustrates another embodiment of the present invention, an underpad 180 for use in conjunction with contact sports shoulder pads. Underpad 180 has a structure which includes numerous compound curves and a plurality of "Swiss-cheese" holes through its structure. The compound curve-forming ability and the plurality of holes permit the pad to conform to and bend over the wearer's shoulder with comfort and breathability. It is a special advantage that the present invention makes these complex curves possible and provides superior shock and impact absorption in such settings.

FIG. 21 illustrates another embodiment of the present invention. It shows pad 210 in which the foam core 11 is surrounded by a wall 211 which has been formed around and in intimate adhesion to the core by applying a liquid polymer suspension to the outer surface of the core and then curing the polymer to produce the wall.

In one preferred embodiment, the outer surface is created by spraying several layers of a curable polymer suspension onto the open-cell foam of core 11. Typical polymer suspensions are the urethane suspensions such as the two part sprayable system marketed by Technical Urethanes, Inc, Clearbrook, Va. as Techthane 90SS. This representative material is a mixture of an aliphatic poly(ether urethane) and a curing agent. These two materials are mixed in about equal volume ratio and applied typically with an airless sprayer at a viscosity of 100-200 cps. This suspension has a solids content of about 45-50% by weight which, when coupled with the viscosity just recited, gives rise to minimal soak-in into the open-cell foam. The material cures to a tightly adhered layer around the core at room temperature or can be quick-cured by the application of heat. Additional layers of the suspension can be applied to produce the desired strength and thickness of coating.

As noted above, the coating can be applied by dipping, as well, when the solids content of the suspension is above about 50% by weight. This coating can be carried out with improved efficiency when the core is preheated and this preheat condition is maintained during the coating, or at least the initial stages of the coating.

Under atmospheric conditions, this process will give rise to a shock-absorber having an atmospheric pressure within the core. This pressure can be increased by adding additional pressurization fluid to the core. This can be carried out using a valve as has been previously described or alternatively can be carried out as depicted in FIG. 21 by injecting fluid such as a gas directly through the wall 211 by means of a needle 213. In the figure, this gas is supplied through line 212. Wall 211 can be self-sealing, or a sealant can be applied over the hole created by needle 213 so as to assure the retention of the pressure applied from line 212.

As previously noted, in some embodiments, the core or the shock-absorber can be pressurized using the process of diffusion pumping as disclosed in U.S. Pat. Nos. 4,219,945 and 4,271,606, both of which illustrate typical materials for forming walls suitable for this process and are incorporated by reference. FIGS. 22A and 22B illustrate this process in schematic view. In these figures, FIG. 22A illustrates a shock-absorber 220 having a spray- on outer wall 211 and a pressurizable open-celled foam core 11. Large molecule gas is present within the voids or cells of core 11. These large molecules are fancifully shown as 221, even though, of course they can not in fact be seen. These molecules are held and enclosed by wall 211 and can not escape as shown representationally by their bouncing off of the wall. Absorber 220 is at a low pressure mode as shown by its flat to concave section. Wall 211 is fabricated of a material which is permeable to small gas molecules and in particular nitrogen and oxygen molecules from air, shown as 222. These small molecules permeate the wall and cause the internal pressure of core 11 to increase. This effect is shown in FIG. 21B where the diffused "small" molecules have entered the core and caused it to press against the affixed wall 211 and expand the body. This pressurization by diffusion can lead to enhanced life for the shock-absorbers and to increased performance.

The effectiveness of the present invention can be demonstrated by comparative tests. A series of impact tests were run on a standard state-of-the-art basketball shoe. The same tests were then performed on the same model shoe which had been modified by replacing a portion of its sole structure (the heel pad region) with an impact absorber of this invention. The impact absorber was fabricated from 35 mil flexible poly(urethane). The core was about ½ inch thick open-cell poly(urethane) foam of 5 lbs per cubic foot density. The foam core slightly prestressed the outer wall by being somewhat oversized and was adhered to the walls using a heat activated water-based urethane adhesive. Tests were run with the core sealed at atmospheric pressure and with the core pressurized to 5 and 10 psig. FIGS. 19 and 20 present the results of these tests. In each figure line A is the results observed with the prior art shoe. It can be seen that for a given application of energy to the shoe, i.e. a given impact, the shoe transmits a certain peak force and a certain acceleration, (in G's) to the wearer. Lines B show the results achieved when the atmospheric bladder is used. They show that the force and acceleration transmitted to the wearer is significantly reduced. Importantly, this reduction occurs over the entire range of applied energies. Thus the effectiveness of the present absorbers is substantially universal and will be observed with hard impacts such as may result with heavy athletes and also with lighter impacts such as may result with lighter weight athletes, etc.

Lines C show that even better shock-absorbancy is achieved when a positive pressure is applied to the bladders. Similar results were obtained with the 5 and 10 pound pressures which suggest that in practical terms these pressures may be quite adequate. On the basis of these tests, it is believed that pressures in the range of 0 to about 20 psig are preferred.

The present invention has been described herein in detail with respect to a number of preferred embodiments and configurations. It will be appreciated, however, that modifications and changes to various aspects of these embodiments may be made while still coming with in the spirit and scope of this invention which is as defined by the following claims.

The term "solution/suspension", as used in the above specification and as used in the following claims, is

intended to means "solution/suspension" and has been used as an abbreviation of such.

What is claimed is:

1. A method for producing a shock-absorbing composite for absorbing and dispersing impacting forces comprising forming a flexible foam core shaped and sized as required for said shock-absorbing composite, applying to the outer surface of said core a layer of prepolymer solution/suspension, curing the layer of prepolymer solution/suspension to yield a flexible plastic layer thereby forming a flexible enclosure surrounding and adhered on all sides to said core, said flexible enclosure being capable of having its internal pressure changed.

2. The method of claim 1 wherein said applying is carried out by dipping and wherein the solution/suspension is a suspension having a solids content of at least about 50% by weight.

3. The method of claim 2 wherein said suspension has a solids content of from about 50% by weight to about 75% by weight.

4. The method of claim 1 wherein the core is preheated to a temperature above ambient prior to applying to its outer surface the layer of prepolymer solution/suspension and wherein said core is at a temperature above ambient during application of the layer.

5. The method of claim 4 wherein the preheat temperature is a temperature between 80° F. and the thermal decomposition temperature of the core.

6. The method of claim 4 wherein the preheat temperature is a temperature between 90° F. and 250° F.

7. The method of claim 6 wherein the core is an open-celled foam core.

8. The method of claim 7 wherein the applying is effected by spraying.

9. The method of claim 6 wherein said applying is carried out by dipping and wherein the solution/suspension is a suspension having a solids content of at least about 50% by weight.

10. The method of claim 9 wherein said suspension has a solids content of from about 50% by weight to about 75% by weight.

* * * * *

United States Patent [19]

Donzis

[11] **Patent Number: 4,486,901**

[45] **Date of Patent: Dec. 11, 1984**

[54] **MULTI-LAYERED, OPEN-CELLED FOAM SHOCK ABSORBING STRUCTURE FOR ATHLETIC EQUIPMENT**

[75] Inventor: **Byron A. Donzis, Houston, Tex.**

[73] Assignee: **Houston Protective Equipment, Inc., Houston, Tex.**

[21] Appl. No.: **478,681**

[22] Filed: **Mar. 25, 1983**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 357,588, Mar. 12, 1982, abandoned.

[51] Int. Cl.³ A41D 13/00

[52] U.S. Cl. 2/2; 2/22

[58] Field of Search ..... 2/2, 22, DIG. 3; 5/434

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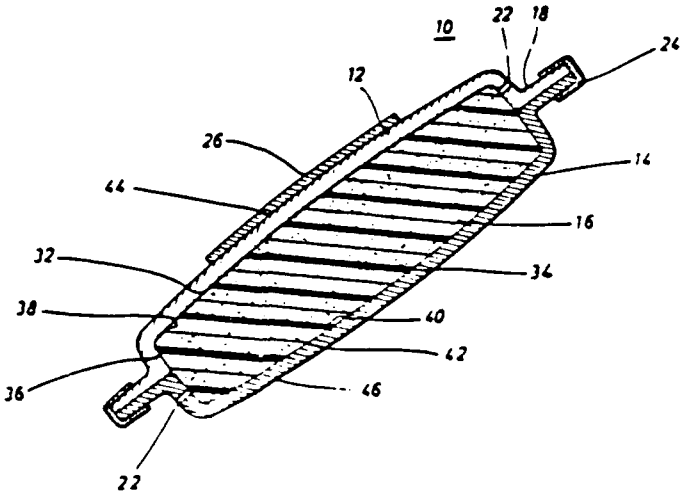
Primary Examiner—Louis K. Rimrodt

Attorney, Agent, or Firm—Arnold, White & Durkee

[57] **ABSTRACT**

Shock absorbing structure for athletic equipment is disclosed in which a flexible air-tight fabric structure has an internal surface defining a cavity and an external surface adapted to be in fluid communication with the atmosphere outside the shock absorbing structure. The fabric structure includes a plurality of selectively dimensioned and disposed apertures which couple the cavity and the external surface of the shock absorbing structure in continuous fluid communication. A flexible foam portion having an open-celled structure defining a reservoir to releasably hold air is disposed in the cavity of the fabric structure and bonded, at least in part, to at least a portion of the internal surface of the fabric structure. In one embodiment, the flexible foam portion includes a multi-layered laminate of at least three open-celled foams of different foam density. The shock absorbing structure further includes shield structure to distribute the applied force across at least a portion of the fabric covered foam laminate.

9 Claims, 13 Drawing Figures



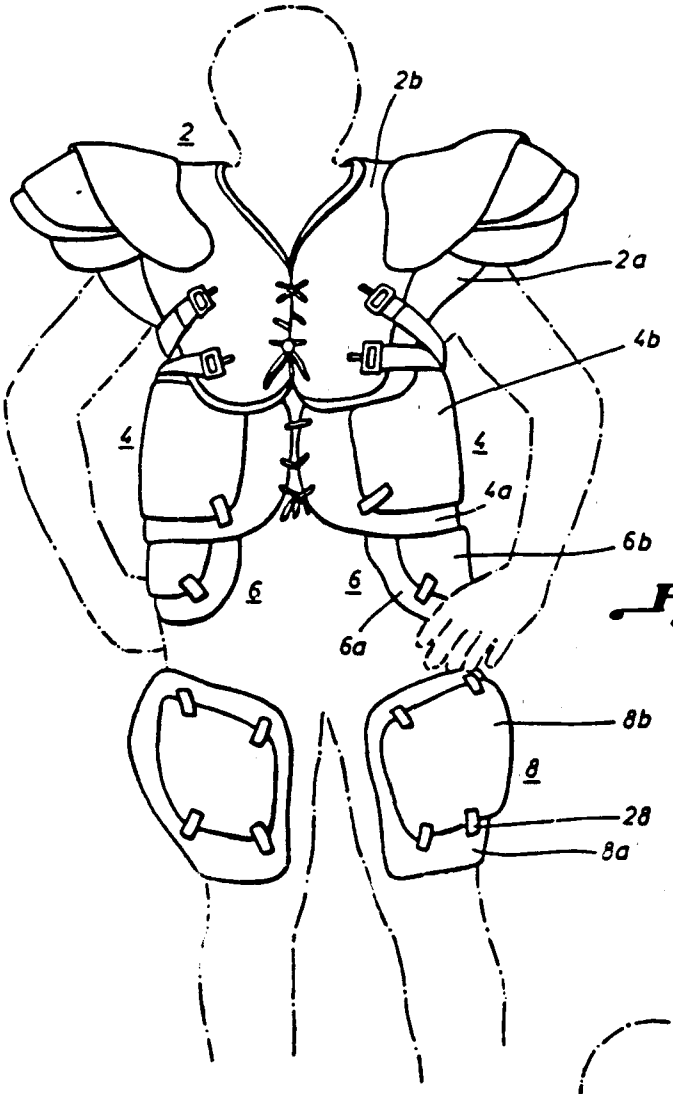


Fig. 1

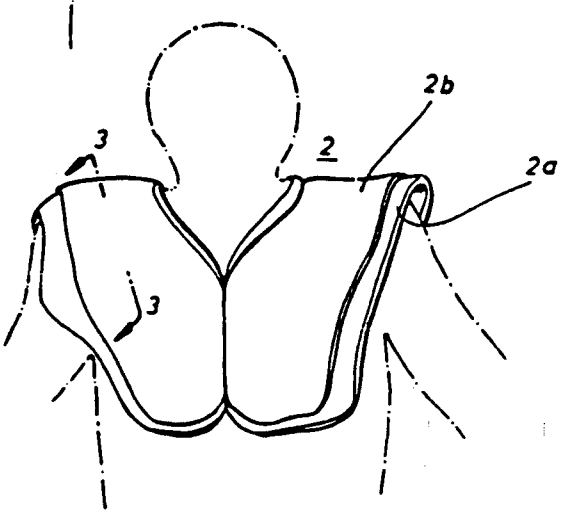


Fig. 2

Fig. 3

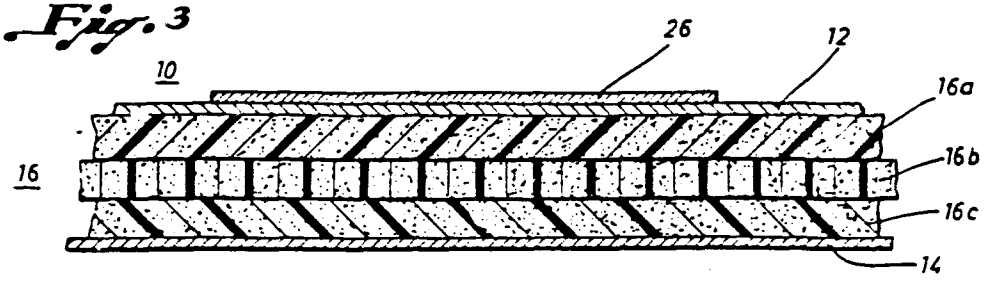
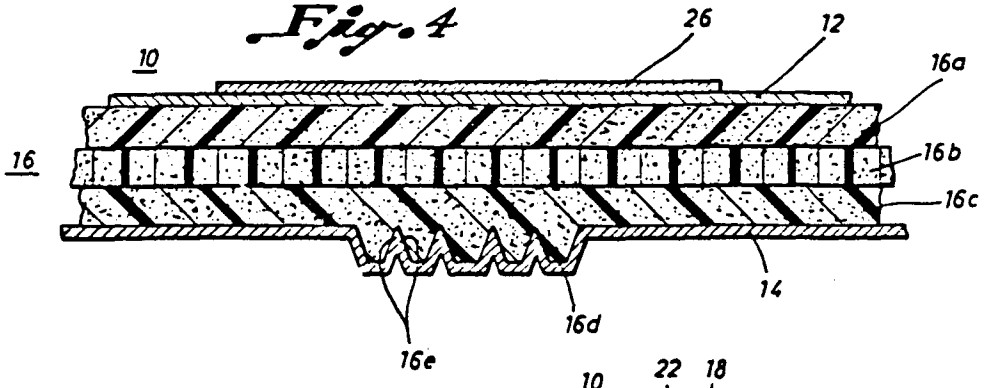


Fig. 4



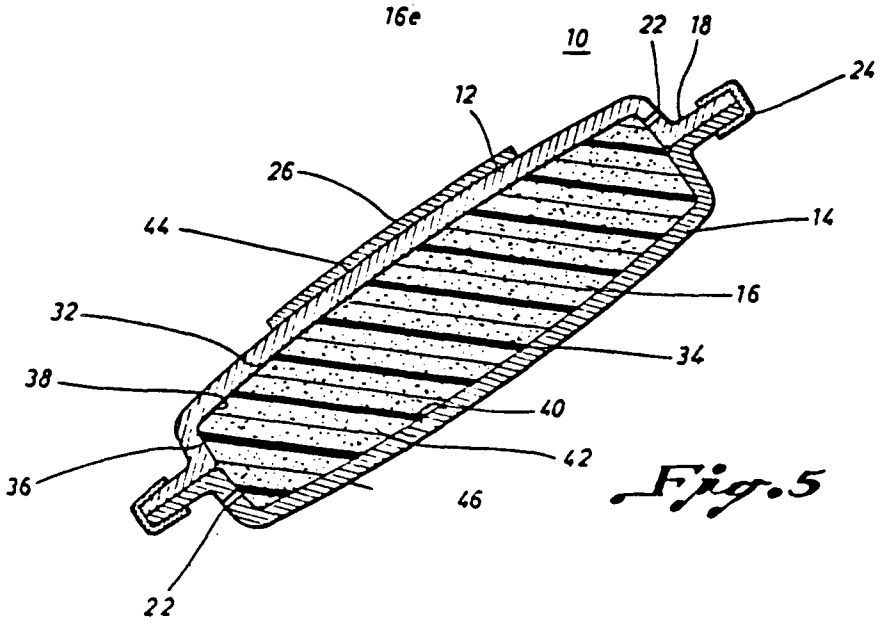


Fig. 5

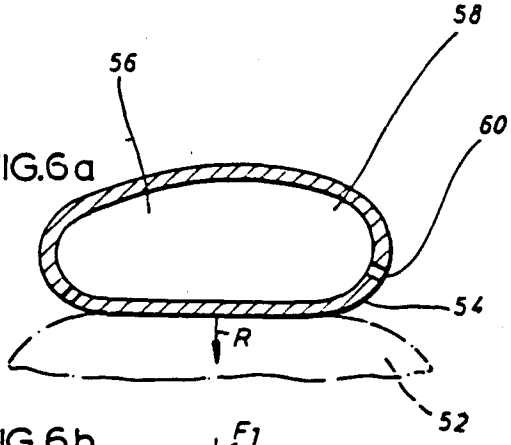


FIG.6a

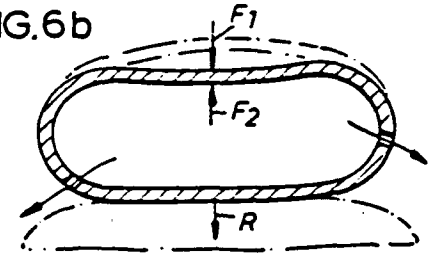


FIG.6b

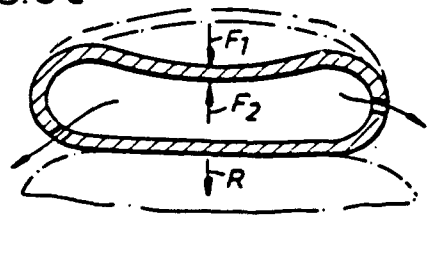


FIG.6c

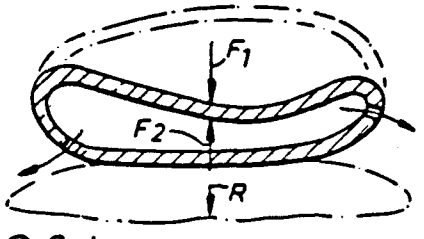


FIG.6d

FIG.6e

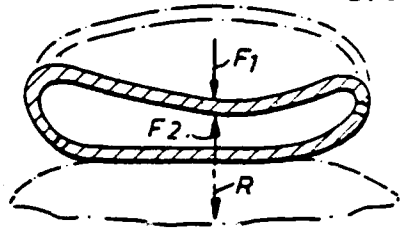


FIG.6f

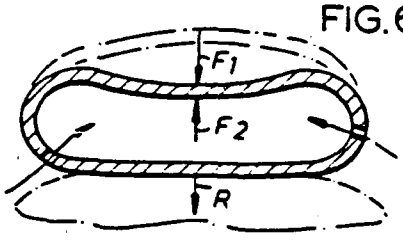
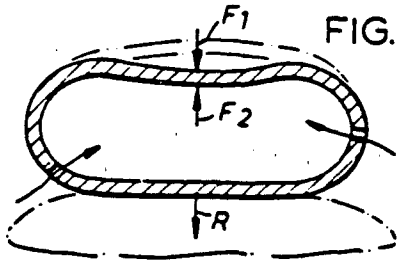


FIG.6g



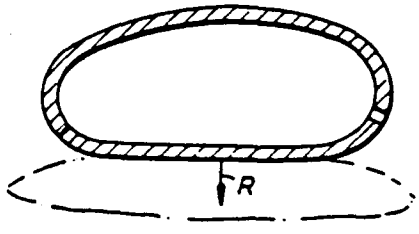


FIG.6h

MULTI-LAYERED, OPEN-CELLED FOAM SHOCK ABSORBING STRUCTURE FOR ATHLETIC EQUIPMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation-in-part of my earlier application, Ser. No. 357,588, filed on Mar. 12, 1982, for Protective Shock Absorbing Equipment, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to shock absorbing equipment, and more particularly to protective shock absorbing athletic equipment for wear during contact sports, and to methods for making such equipt.

Shock absorbing equipment has long t en known and used where shock attenuation is required. For example, to reduce the trauma inflicted upon people in vehicle collisions, closed-cell foam materials have been used in automobile dash boards, sand-filled barrels have been deployed about highway obstructions, and air-bags that inflate upon vehicle impact have been used in passenger compartments. Raw cotton and wool batting have been used for padding and packaging needs, and both batting and inflatable members have been used in clothing and athletic equipment.

Athletic equipment, such as shoulder pads, rib protectors, hip pads, thigh pads, and so forth, are commonly worn by participants in a great variety of sports in which body contact with either another participant or with a piece of equipment used in the sport presents the risk of injury. Such equipment has long been known and used by athletes in contact sports such as football, hockey and so forth.

One type of known prior art athletic equipment includes a relatively hard outer shell of leather, vulcanized fiber, or similar material, and an inner layer of soft padding material. So constructed, the hard outer layer receives the applied force or shock and serves to spread the force over a large area where it is absorbed and cushioned by the soft padding material. Known prior art padding materials include cotton padding, foam rubber, foam plastic material, sponge rubber, expanded rubber or vinyl and the like, with the resilience of such material tending to absorb a portion of the applied force.

Another known type of athletic equipment includes an inflatable balloon-like structure which is inflated with air to a pressure above one atmosphere and then sealed to maintain the air within the structure. When a force is imparted to such a structure, a portion of the air volume within the structure immediately adjacent the point of contact on the structure is forced to another region within the structure causing the entire structure to balloon. This ballooning effect tends to redistribute the applied force in the same manner that stepping on one end of an elongated balloon redistributes the applied force to the other end of the balloon causing the other end to bulge.

The known prior art shock absorbing equipment, however, does not effectively reduce the force actually imparted to the user to a negligible value.

SUMMARY OF THE INVENTION

According to the present invention, shock absorbing structure for athletic equipment is provided for controlled shock attenuation. While the present invention has many applications, it will generally be described with reference to athletic equipment. It will be apparent to those skilled in the art that the present teachings may advantageously be employed in other applications where controlled shock attenuation is required

The present invention utilizes a controlled transfer of air between an interior region and the atmosphere outside the piece of shock absorbing equipment to present the force inflicted upon the equipment with an oppositely directed force of substantially equal magnitude to impart to the wearer a substantially negligible resultant force.

According to one embodiment of the present invention, a flexible open-celled foam portion is covered with a fabric. The fabric is generally air impermeable, but has a plurality of air permeable regions selectively distributed. The air permeable regions produce continuous fluid communication between the foam portion inside the fabric covering and the atmosphere outside. Upon application of a force to the fabric covering, a portion of the volume of air contained within the cell structure of the foam is selectively transferred through the air permeable regions of the fabric covering to the outside of the covering. The rate of transfer is controlled such that the inflicted force is met with a resistance of substantially equal magnitude and opposite direction to produce a resultant force of substantially negligible magnitude for infliction upon the wearer. Shield structure is included to distribute the force across the fabric covered foam.

According to one aspect of the present invention, the flexible open-celled foam portion includes a multi-layered laminate of open-celled foams having different foam densities. In one embodiment of the present invention, the laminate includes at least three foam layers. In another embodiment, the laminate includes a plurality of foam layers disposed adjacent an inflatable-deflatable structural element.

According to another aspect of the present invention, a method for making shock absorbing structure for athletic equipment includes cutting open-celled foam into a desired pattern, bonding an air-tight fabric to the foam to form an air-tight enclosure about the foam, and inflicting a plurality of holes in the fabric at predetermined locations such that the holes penetrate through the fabric and into the cell structure of the foam.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will further be described with reference to the accompanying drawings which illustrate shock absorbing structure for athletic equipment in accordance with the present invention, wherein like members bear like reference numerals and wherein:

FIG. 1 is a perspective view of football shoulder pads, a rib protector, hip pads and thigh pads in accordance with the present invention,

FIG. 2 is a perspective view of a portion of the shoulder pads illustrated in FIG. 1,

FIG. 3 is a section view through the shoulder pad illustrated in FIG. 2 along the line 3—3, with the structure layed substantially flat

FIG. 4 is an alternate embodiment of the structure illustrated in FIG. 3,

FIG. 5 is a schematic cross-section view of shock absorbing structure according to the present invention, and

disposed adjacent the second piece of fabric 14, and the foam layer 16b is disposed between the foam layers 16a and 16c.

Each foam layer 16a, 16b and 16c have a different foam density. The density of the foam layer 16c, which is designed to be disposed adjacent the body of the wearer, has the lowest foam density. Its foam density should be no more than approximately one pound per cubic foot. The preferred range of densities is between one-half and three-quarter pound per cubic foot.

Soft foam is used in foam layer 16c to enhance comfort levels and provide proper fit. Since the structure 10 must be shaped to conform to the body of the wearer, the foam layer 16c must have sufficient softness to conform to the contour of the body while providing good body contact.

To further enhance fit and comfort, an alternate embodiment illustrated in FIG. 4 includes a foam layer 16c having a plurality of regions 16d of varied height. In operation, as the structure 10 is fitted about the body, sides 16e of the height-varied regions 16d move closer together and tend to form a firmer fit than the structure illustrated in FIG. 3.

Referring once again to FIG. 3, the outer foam layer 16a has a relatively high foam density. The density range is from approximately 3 pounds per cubic foot to 16 pounds per cubic foot or more. The preferred range is approximately 3 to 4 pounds per cubic foot.

The foam layer 16b sandwiched between the high density outer foam layers 16a and the low density inner foam layer 16c has an intermediate density between the densities of the inner and outer foam layers. The preferred density of the foam layer 16b is approximately 2 pounds per cubic foot.

The foam portion 16 in the illustrated embodiment has three foam densities by virtue of having three foam members, 16a, 16b and 16c. More than three foam members may be used. It is important that the foam layer closest the body have a low enough density for enhanced comfort and fit, and the density of the layer furthest from the body be sufficiently great so that the shock absorbing structure 10 adequately absorbs the inflicted force.

In alternate embodiments (not illustrated) an inflatable-deflatable structural element is used in place of either foam layer 16a or foam layer 16c. The foam portion 16 in these alternate embodiments is a multi-layered laminate of a plurality of open-celled foams having different foam densities, and the inflatable-deflatable structural element is disposed adjacent the multi-layered foam laminate. The inflatable-deflatable structural element includes an inflatable-deflatable chamber, and may include open-celled foam disposed within the chamber.

Referring now to FIG. 6a, a schematically illustrated shock absorbing structure 10 disposed adjacent a wearer 52 includes an air-tight fabric enclosure 54 having a cavity 56. Flexible open-celled foam portion 58 is disposed within the cavity 56 such that the outer surface of the foam portion is bonded to the inner surface of the cavity. A plurality of apertures 60 are included in the air-tight fabric enclosure 54 and provide continuous fluid communication between the cavity 56 and the atmosphere outside the shock absorbing structure 10.

Referring to FIG. 6a, in the absence of an external force inflicted upon the shock absorbing structure 10, the cells of the foam portion 58 in the cavity 56 contain a first volume of air at one atmosphere of pressure. The pressure within and without the shock absorbing structure 10 is the same because apertures 60 reduce the pressure differential across the portion of the fabric enclosure 54 containing the air-permeable apertures 60 to a quiescent value of zero. Since the inflicted external force is zero, the resulted force R transmitted to the wearer 52 is also zero.

Referring now to FIG. 6b, a force F_1 is inflicted upon the shock absorbing structure 10. In the absence of the apertures 60, the inflicted force may tend to distort the shape of the cavity 56, but it cannot alter the volume of air contained within the cavity 56 because air is essentially an incompressible fluid. On the other hand, if the apertures 60 were uncontrollably large, the inflicted force F_1 would tend to collapse the structure 10 expelling the air contained within the cellular structure of the foam portion 58 through the aperture 60. In either case, a significant portion of the inflicted force would likely be imparted to the wearer. Controlled expulsion of the air contained in the cellular structure, however, reduces the resultant force imparted to the wearer to substantially zero.

As the force F_1 is inflicted upon the shock absorbing structure 10, a portion of the air contained in the cellular structure of the foam portion 58 is transferred from the cavity 56, through the apertures 60, and into the atmosphere outside the structure 10. The volume of air transferred per unit of time, which is determined by the size and number of the apertures 60, is chosen to create a back pressure in the cavity 56 which presents the inflicted force F_1 with a force F_2 of equal magnitude and opposite direction. The forces F_1 and F_2 vectorially add such that the resultant force R imparted to the wearer 52 is essentially zero.

The force F_1 exists for some finite period of time and thus can be viewed as increasing in magnitude from zero to some maximum value, dwelling at that maximum value for some finite period of time, and then decreasing from that maximum value to zero. FIGS. 6b, 6c and 6d schematically illustrate the behavior of the shock absorbing structure 10 as the inflicted force increases to its maximum value.

As the magnitude of the force increases, the pressure within the cavity 56 increases to a value above one atmosphere and air within the cellular structure of the foam portion 58 is expelled through the apertures 60. Both the air pressure in the cavity and the volume of the cavity decrease.

As the force F_1 reaches its maximum value, the rate of change of F_1 per unit of time reaches zero. Therefore, the rate of change of cavity volume per unit of time and the volume of air expelled from the cavity per unit of time also reach zero. This is depicted in FIG. 6e.

The inflicted force F_1 then decreases in magnitude from the maximum value to zero, and the elasticity of the foam portion 58 causes the cavity 56 to increase in volume. As the volume increases, air is drawn through the apertures 60 and into the cavity 56 from the atmosphere outside the shock absorbing structure 10. This is schematically illustrated in FIGS. 6f and 6g. The rate at which air is drawn into the cavity 56 and thus the rate at which the volume of the cavity increases, is again determined by the number and size of the apertures 60 and is chosen such that the forces F_1 and F_2 add vectorially to produce a resultant force R of substantially zero magnitude.

After the magnitude of the inflicted force F_1 has decreased to zero, the cavity 56 returns to its initial

said inner foam layer has a foam density in the range of approximately one-half to three-quarter pound per cubic foot;

said outer foam layer has a foam density in the range of approximately three to four pounds per cubic foot; and

said intermediate foam layer has a foam density of approximately two pounds per cubic foot.

5. The shock absorbing structure of claim 1 wherein the open-celled foam layer of the foam portion adapted to be disposed adjacent the wearer comprises a plurality of height-varied regions adapted to conform to a body contour of said wearer.

6. Shock absorbing structure for athletic equipment to protect a wearer from infliction of an externally applied force, comprising:

a flexible enclosure having first and second faces and a periphery defining a cavity, said first and second faces being air impermeable and said periphery having at least one air impermeable region and at least one air permeable region such that said cavity is in continuous fluid communication with the atmosphere outside the shock absorbing structure;

a member having first and second faces disposed adjacent to and bonded at least in part to said first and second faces, respectively, of the flexible enclosure, said member including:

an inflatable-deflatable structural element; and

a flexible open-celled foam portion disposed adjacent said inflatable-deflatable structural element and comprising a multi-layered laminate of open-celled foams of different foam density including first and second foam layers each having two faces, one face of said first foam layer being bonded to one face of said second foam layer, the cells of said foam portion releasably holding a volume of air selectively varied between first and second volumes differing by a volume differential in response to application and removal of the force on the shock absorbing structure, said volume differential being transferred between the foam portion and the atmosphere outside the shock absorbing structure through said at least one air permeable region of the periphery of the flexible enclosure; and

shield structure dispoed outside said flexible enclosure and adjacent one of said first and second faces of said flexible enclosure to distribute the applied force across at least a portion of said one of said first and second faces.

7. The shock absorbing structure of claim 6 wherein said inflatable-deflatable structural element includes an open-celled foam member.

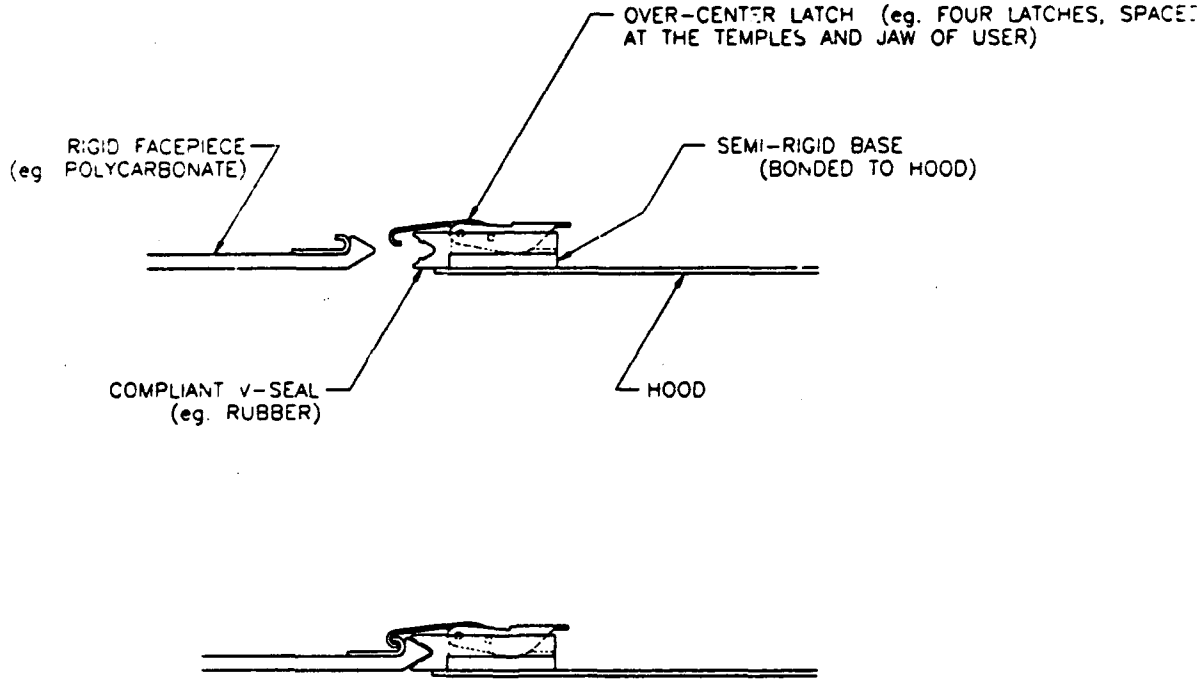
8. The shock absorbing structure of claim 6 wherein said inflatable-deflatable structural element is disposed adjacent said shield structure.

9. The shock absorbing structure of claim 6 wherein one of the open-celled foam layers of the foam portion comprises a plurality of height-varied regions adapted to conform to a body contour of said wearer.

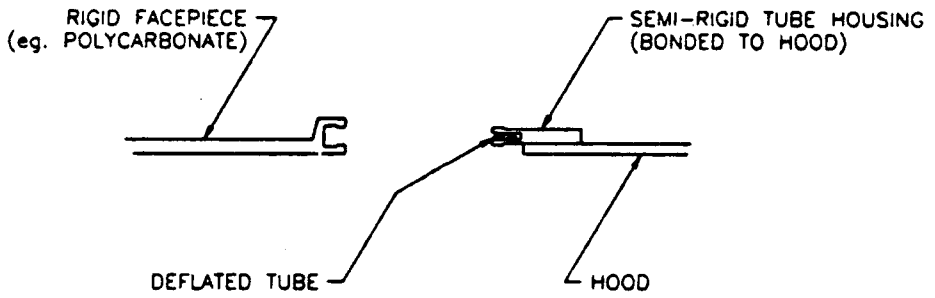
* * * * *

APPENDIX C

MASK ATTACHMENT CONCEPTS


OVER-CENTER LATCH (eg. FOUR LATCHES, SPACED AT THE TEMPLES AND JAW OF USER)
RIGID FACEPIECE (eg POLYCARBONATE)
SEMI-RIGID BASE (BONDED TO HOOD)
COMPLIANT V-SEAL (eg. RUBBER)
HOOD

CONCEPT #1

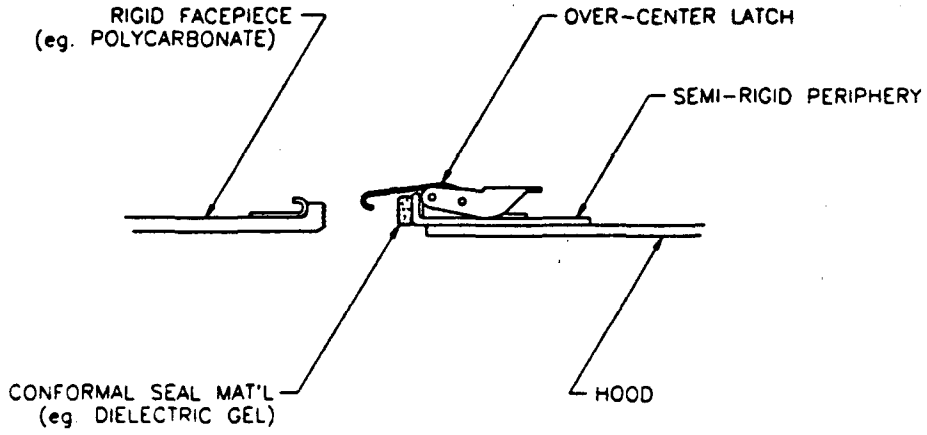


SNAP IN PLACE

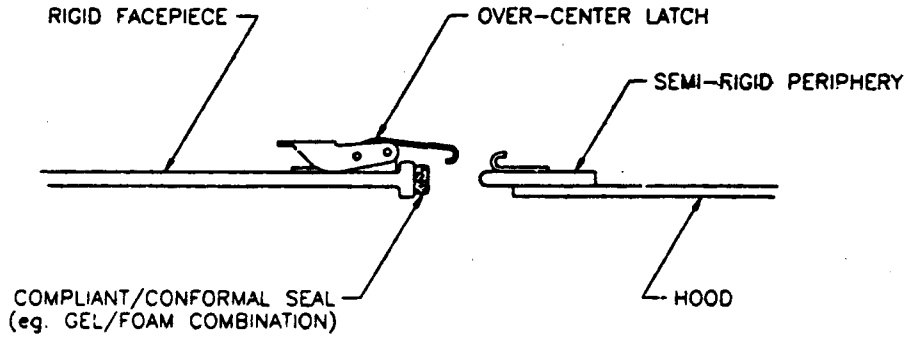
(PASSIVE ATTACHMENT)

(PNEUMATICALLY OR HYDRAULICALLY INFLATE TUBE TO LOCK SEAL)

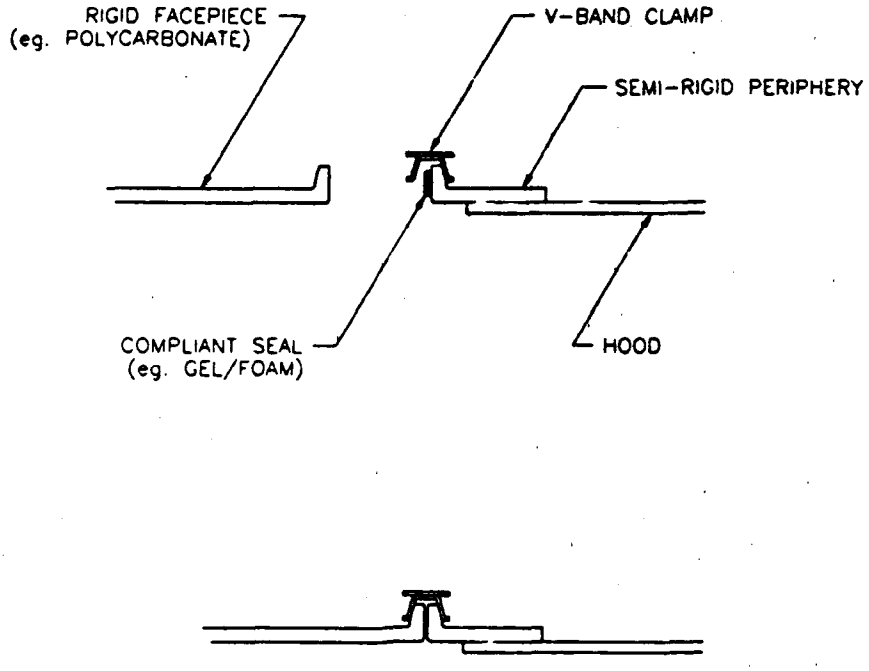
CONCEPT #2


RIGID FACEPIECE
(eg. POLYCARBONATE)
OVER-CENTER LATCH
SEMI-RIGID PERIPHERY
CONFORMAL SEAL MAT'L
(eg. DIELECTRIC GEL)
HOOD

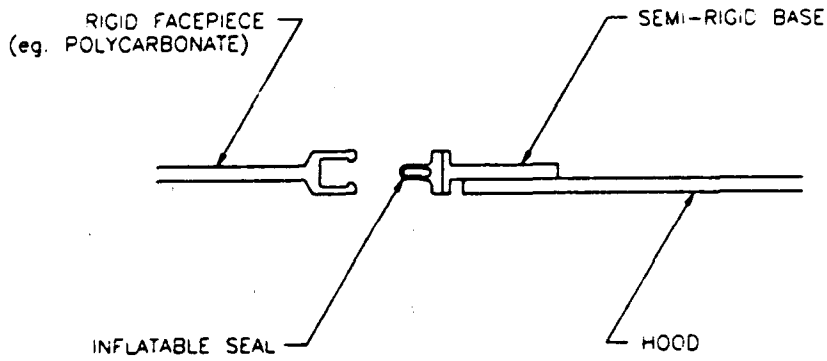
CONCEPT #3

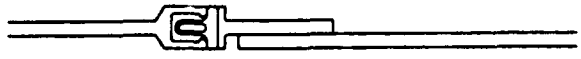

RIGID FACEPIECE
OVER-CENTER LATCH
SEMI-RIGID PERIPHERY
COMPLIANT/CONFORMAL SEAL
(eg. GEL/FOAM COMBINATION)
HOOD

CONCEPT #4

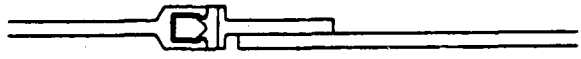

RIGID FACEPIECE
(eg. POLYCARBONATE)
V-BAND CLAMP
SEMI-RIGID PERIPHERY
COMPLIANT SEAL
(eg. GEL/FOAM)
HOOD

CONCEPT #5





(SEAL CONTACT)

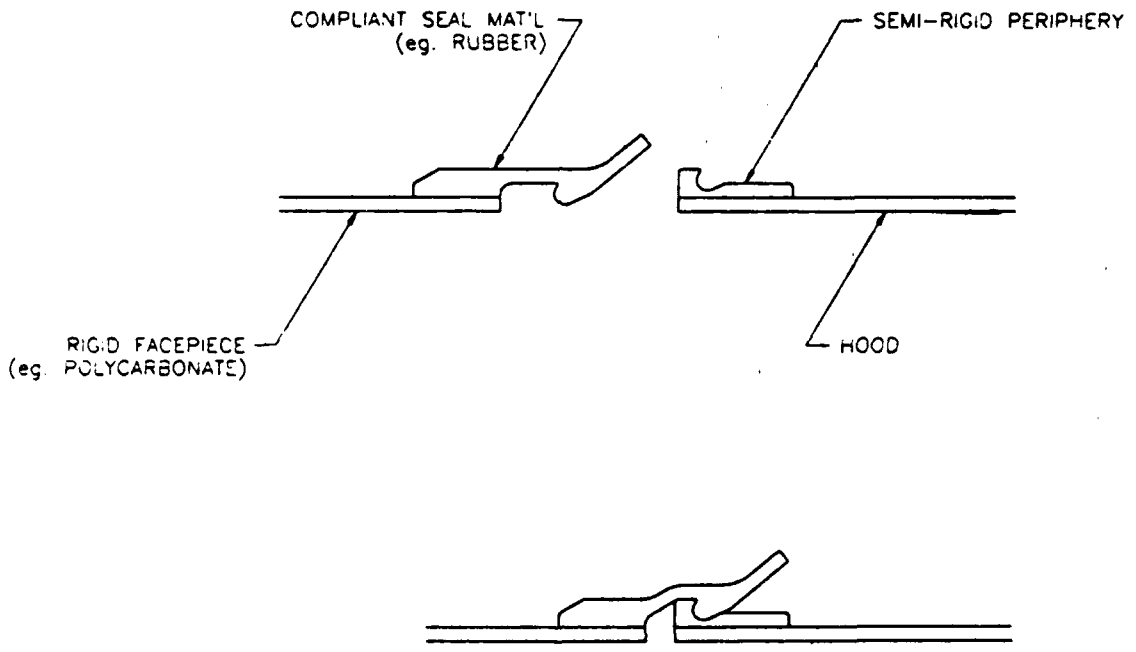


(PNEUMATIC OR HYDRAULIC
SEAL INFLATION)

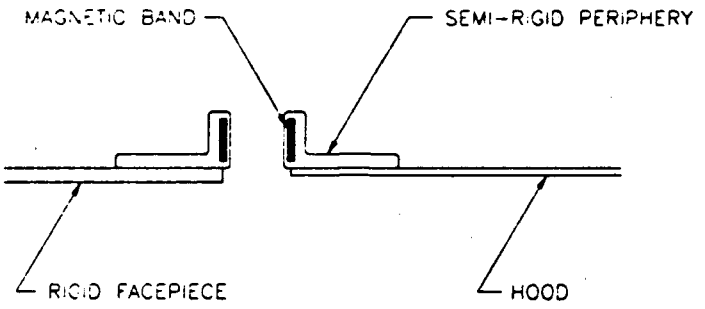
NOTES:

1. UPON INFLATION, THE SEAL COMPLETELY FILLS THE FACEPIECE VOID.
2. UPON INFLATION, THE SEAL EFFECTIVELY LOCKS THE FACEPIECE TO THE BASE.

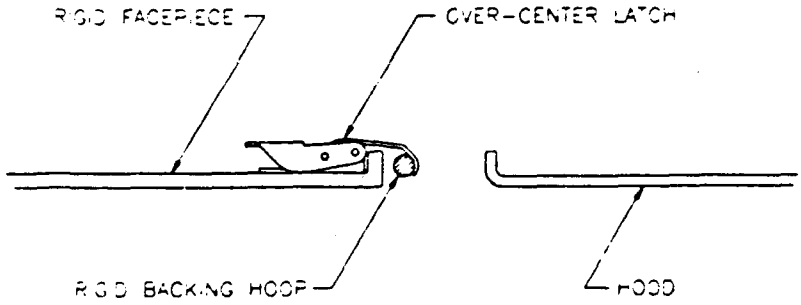
CONCEPT #6


COMPLIANT SEAL MAT'L
(eg. RUBBER)
SEMI-RIGID PERIPHERY
RIGID FACEPIECE
(eg. POLYCARBONATE)
HOOD

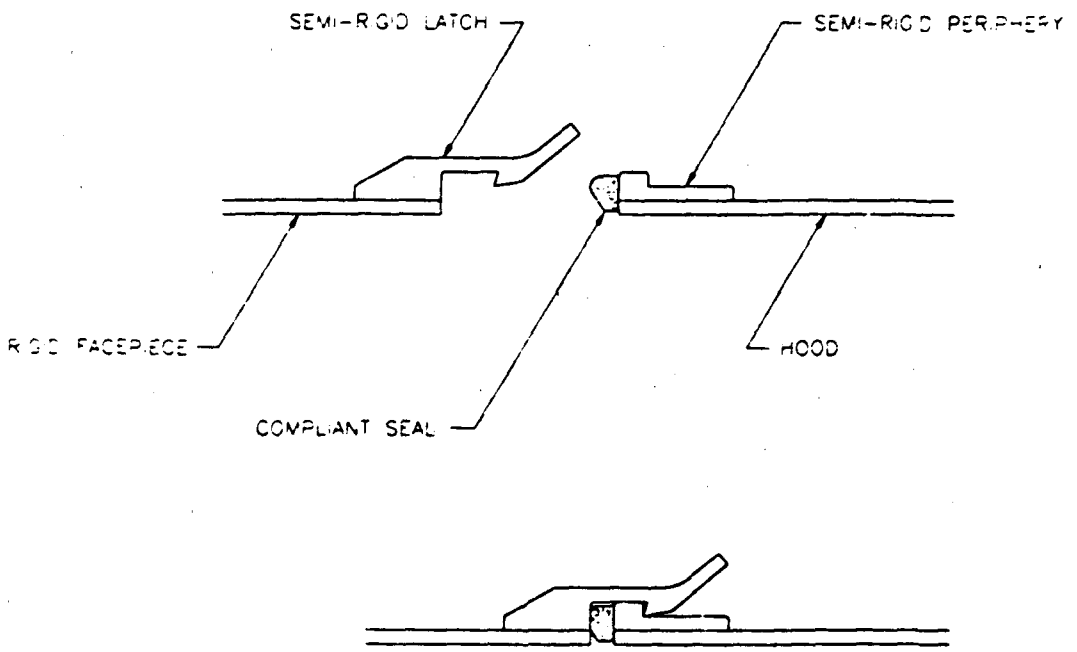
CONCEPT #7



CONCEPT #8



CONCEPT #9


SEMI-RIGID LATCH
SEMI-RIGID PERIPHERY
RIGID FACEPIECE
HOOD
COMPLIANT SEAL

CONCEPT #10